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ATOLL RESEARCH BULLETIN

165. CENTRAL WESTERN INDIAN OCEAN BIBLIOGRAPHY

By A. J. Peters and J. F. G. Lionnet

Issued by
THE SMITHSONIAN INSTITUTION
Washington, D.C., U.S.A.

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CONTENTS

Maps ii

Introduction 1

Notes 3

Location code 4

Expedition and conference reports 6

Bibliography 7

Indexes 249

- 1. Subjects 251
- 2. Regions 278
- 3. Taxa 303

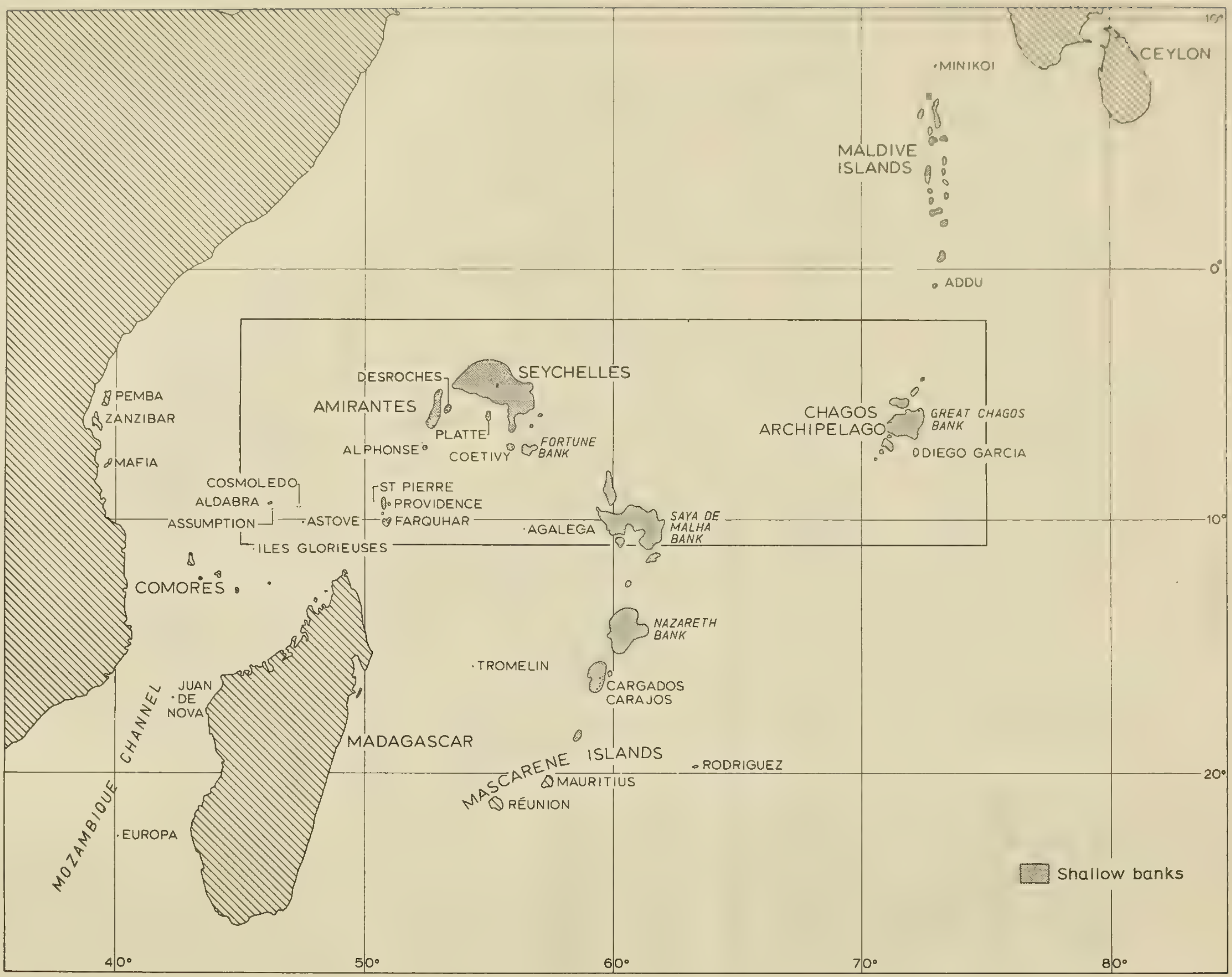

Figure 1. The Central Western Indian Ocean. Rectangle frames area covered by bibliography.

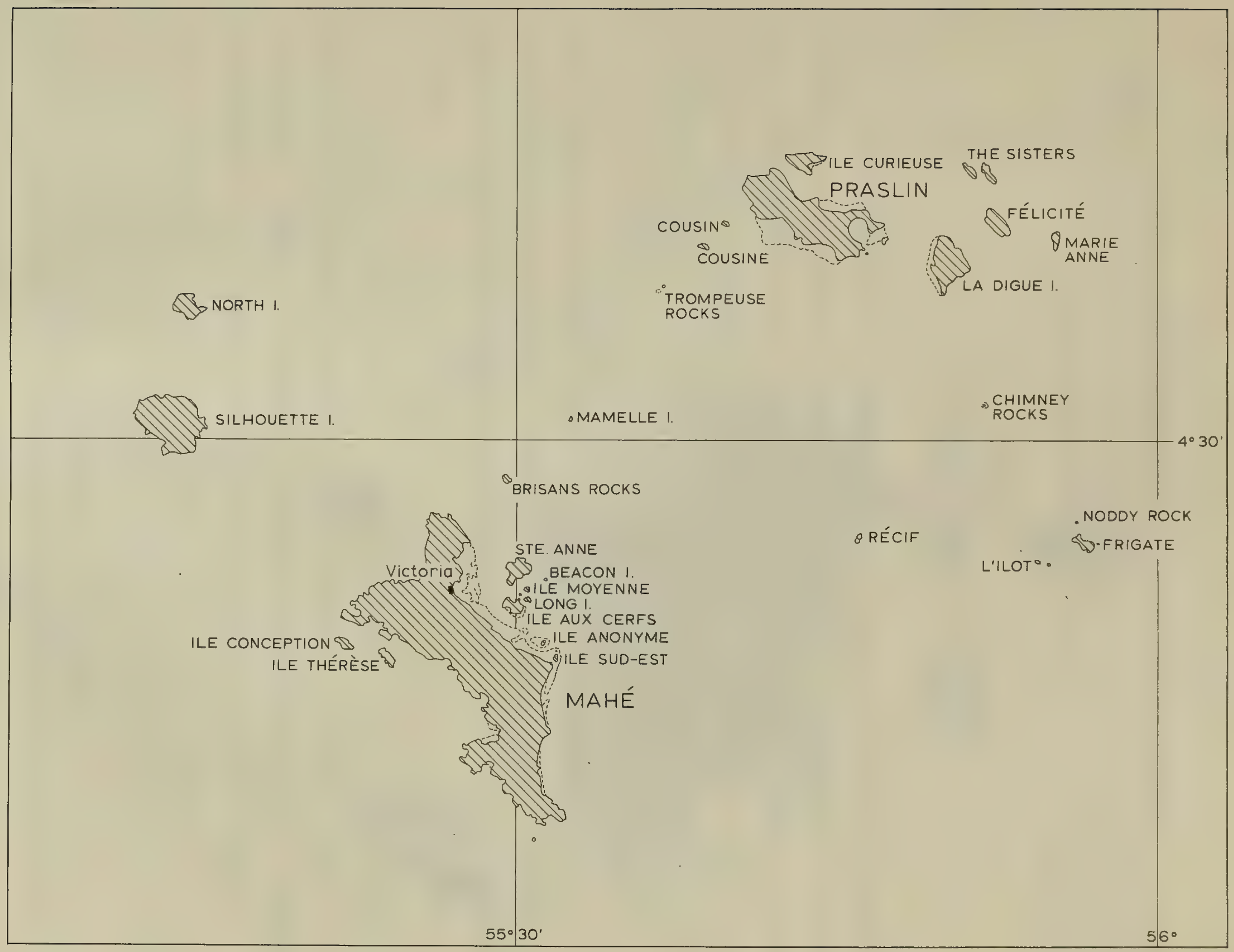

Figure 2. The Seychelles Islands.

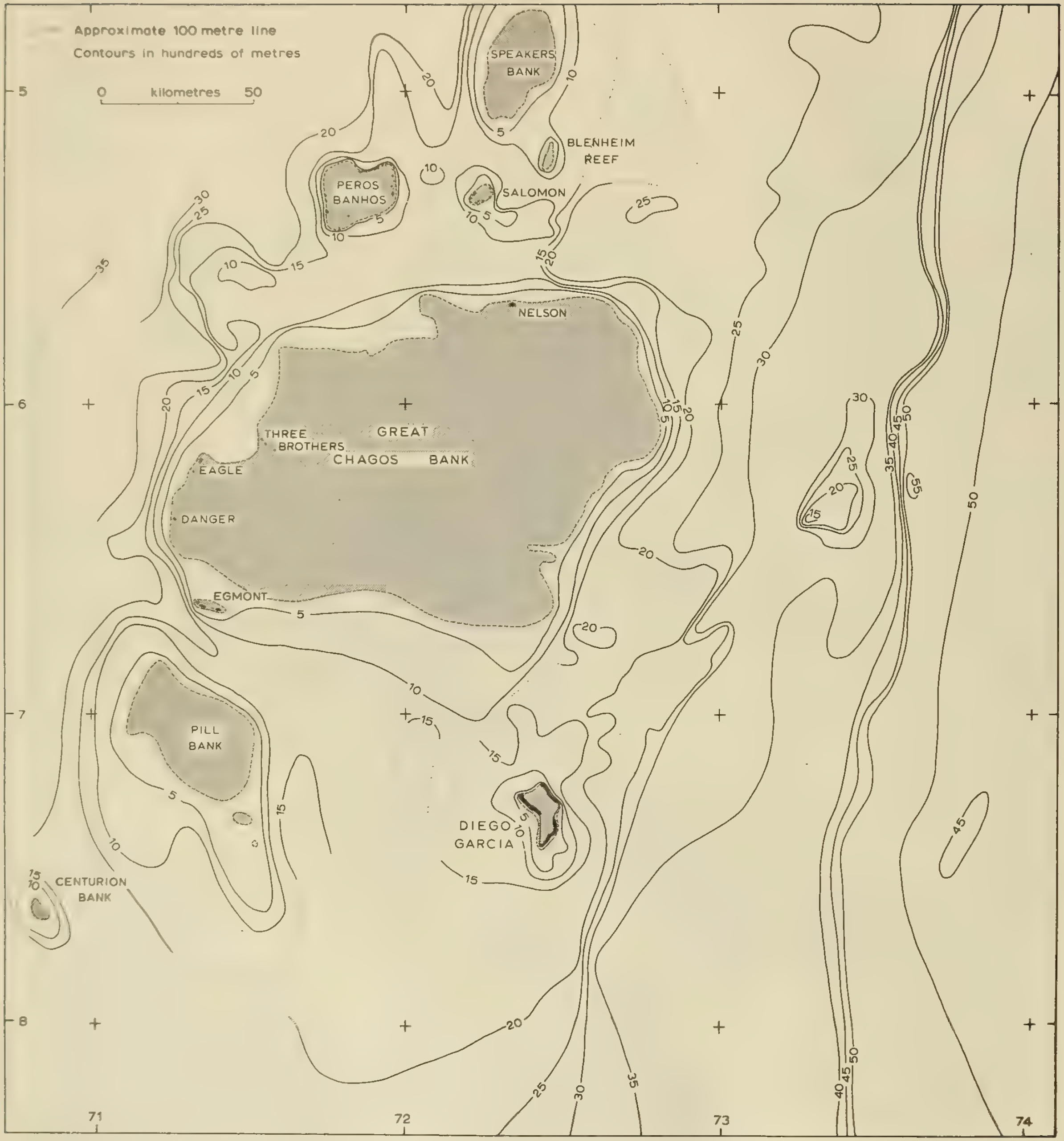

Figure 3. The Chagos Archipelago. From Admiralty Charts and Ocean Plotting Sheets and reproduced with the sanction of the Controller, H.M. Stationery Office and of the Hydrographer of the Navy. (From ARB 149).

CENTRAL WESTERN INDIAN OCEAN BIBLIOGRAPHY

By A. J. Peters[1] and J. F. G. Lionnet[2]

INTRODUCTION

The Indian Ocean, though still the least known of the oceans, has been studied greatly since the international expeditions of the 1960s. This bibliography is offered as a further contribution thereto. It stems from an earlier and much smaller publication by one of us (PETERS, A.J. 1957). It is the fruit of our own reading, and not the result of a systematic search of, say, library catalogues, indexes of journals or collections of abstracts. It provides a key to four and a half centuries of Indian Ocean exploration and research, and is an annotated and indexed list of published scientific work bearing on the smaller British-held islands and included seas in the western Indian Ocean.

The greatest problem in compiling it has been to decide what to leave out. We finally chose an area as the main criterion for inclusion, namely a "rectangle" bounded by latitude 2 to 11° south and longitude 45 to 75° east. Only work which refers specifically to places within this band is in. Here lie all the British-held or formerly British-held islands of the western part of the ocean except Mauritius and Rodriguez. Included, therefore, are the Aldabra, Amirantes, Chagos, Farquhar, Providence and Seychelles groups, the

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[2] Agricultural Department, Seychelles

Agalega Islands and Coetivy Island, and the Fortune, Saya de Malha, Seychelles and Swift Banks. Excluded are the Cargados, Comores, Glorieuses, Laccadive, Maldive and Mascarene groups, Tromelin Island, the Nazareth Bank, the islands of the Mozambique Channel, and, of course, Africa and Madagascar and their coastal islands. The word "scientific" as used above has been interpreted broadly, to include general, narrative and popular accounts, in the social as well as natural sciences, but not narrative political history or contemporary politics. The word "published" includes mimeographed material, but not manuscript or typescript single copies, nor material in preparation. Annotations have usually been omitted where the title was thought to be sufficiently explanatory. The time span is 1519 to 1971.

No bibliography is perfect, and we would be far from claiming that this one is. Omission of material that should have been included is inevitable; and we are particularly conscious of this risk in relation to Japanese and Russian work, and, of course, to publications too recent to have come to our notice. The annotations are not wholly consistent nor the indexes foolproof. Neither of us is a trained bibliographer, librarian or linguist; we have had to do the work in little bits of time over a long period; and we have had almost no assistance. However, at least we can say that nearly every item has been seen and checked at first hand by one of us and marked with a location code to indicate where. The mere 120 or so that have eluded both of us are marked "ns", without a §.

Our thanks are due to the Government of Seychelles, the Trustees of the Leverhulme Foundation and the University of Liverpool for financial aid; to librarians, particularly Anne Fishburn, Geoff Smith and John Vaughan, who have patiently laboured to find the items; to Barbara Evans, Susan Peters and Michael Peters for help with editorial work; and to Inez M. Peters for translation from Russian.

July 1972

NOTES

The order of arrangement of authors' names and the plan of each item are based on recommendations in the British Standards Institution's Bibliographical references (B.S. 1629: 1950) (London, BSI, 1951). Thus the year placed immediately after the author's name is the year of issue, or priority, not necessarily the year appearing on the title page of the printed publication. By "year of issue or priority" is meant the year in which the work was actually communicated or appeared, or as near to that as is known. For example, it might be the year in which a paper was read at a meeting, or received by the editor of a journal, as distinct from the year on the title page of the final published report; or the year in which a manuscript was actually written, as distinct from the year in which a chronicler later published it. Usually the issue and publication dates are the same; but, if different, the latter is given later in the item.

The items are set out as in MILLIMAN 1965.

Abbreviations and contractions of titles of serials are as recommended in World list of scientific periodicals, fourth edition (London, Butterworths, 1963-1965). If the title is not in the List, the same rules are used.

Items are in the same language as that of the title given, unless otherwise annotated. Where the title has been translated into English, the source of the translation is indicated. Text was prepared by A.J.P.

[N.B. Taxonomists using this bibliography are warned that the system of indicating dates of items, as explained above, is totally at variance with the concept of priority of publication followed in biological nomenclature. Therefore the so-called dates of issue or priority, placed immediately after (really under) the authors'names, should not be relied upon by those using the bibliography in working on problems of biological nomenclature; nor should they be relied upon by other readers using library catalogues or other reference works to locate items. Dates within the entries should be watched for.--Eds.]

LOCATION CODE

Items seen in or from a library in UK or Isle of Man (A.J.P.)

London

A	Ministry of Agriculture, Fisheries and Food
B	British Museum
C	Foreign and Commonwealth Office
D	Ministry of Defence
E	Commonwealth Institute of Entomology
G	Royal Geographical Society
K	Royal Botanic Gardens, Kew
M	Meteorological Office
N	British Museum (Natural History)
NC	National Central Library
O	Ministry of Overseas Development
PR	Public Record Office
S	Science Museum
T	Tropical Products Institute
Z	Zoological Society of London

Liverpool

LUA	University of	Liverpool,	Arts Reading Room
LUB	"	"	Botany Department
LUC	"	"	Harold Cohen Library
LUE	"	"	School of Education
LUG	"	"	Geology Department
LUO	"	"	Oceanography Department
LUP	"	"	Physics Department
LUTI	"	"	Tidal Institute
LUTM	"	"	School of Tropical Medicine
LUZ	"	"	Zoology Department
P	Liverpool City Central Libraries		

Boston Spa

NL	National Lending Library for Science and Technology

Rothamsted

R	Rothamsted Experimental Station

Port Erin, Isle of Man

LUM	University of Liverpool, Marine Biological Station

Other libraries are named in full

Items not seen in or from a library in UK or Isle of Man (A.J.P.)

ns	items not seen in or from such a library
it	item traced in an authoritative source (usually given; see also below)
tt	title of serial, but not individual item, traced in an authoritative bibliographical source (see below)
nl	no lending copy of item or serial found in UK or IOM
u	item untraced in a library in UK or IOM

Bibliographical sources mentioned in abbreviated form

BUCOP	*British union-catalogue of periodicals*
IBZ (Dietrich)	*Bibliographie der deutschen Zeitschriften-Literatur*, ser.A
Hinrichs	*Hinrichs' Katalog*
Ulrich	*Ulrich's international periodicals directory*, twelfth edition
WLSP	*World list of scientific periodicals*, fourth edition

Items seen in Seychelles (J.F.G.L.)

§	seen, and a copy thought to be available

Note: an item marked "ns u §" has not been traced in a UK or IOM library but there is thought to be a copy of it in Seychelles

EXPEDITION AND CONFERENCE REPORTS

Many items appeared as parts of symposial reports of expeditions, conferences and so on. Where these reports were unique publications they are usually listed in the Bibliography as separate items in their own right, under the names of their main authors or editors. In the items which appeared in them they are given in a short form for the sake of brevity. Expedition reports are given by their commonly known short title. They can be further identified, if needed, under the names of their main authors or editors as follow:

Albatross Rep.	PETTERSSON and others
Alert Rep.	GUNTHER and others
Dana Rep.	SCHMIDT, E.J. and others
Deckens Reisen	KERSTEN and others
Favorite Rep.	LAPLACE and others
Galathea Rep.	BRUUN, GREVE, SPARCK and others
IIOE Repr.	SCIENTIFIC COMMITTEE ON OCEANIC RESEARCH and INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION (eds.)
Mabahiss Rep.	SEWELL and others
Planet Rep.	REICHS-MARINE-AMT
Valdivia Rep.	CHUN and others

Conference reports, however, do not normally have short titles; so they are given by the name(s) of their main author(s) or editor(s), from which they can be further identified.

Items in reports that appeared not as unique publications but as volumes, parts, etc. of regular serials give the full serial reference. To indicate that they are part of a larger report they are annotated "In . . ." followed by the name(s) of the main author(s) or editor(s) of the whole report, which can then be further identified if desired.

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1962c A preliminary Soviet map of the Indian Ocean. New Scient., 15: 263. [Reprinted from Priroda a map of the central Indian Ocean by ZAMOTSKI, showing topography worked out in RV 'Vityaz' in 1959-1960 and 1960-1961. It was not possible, however, to find this map in Priroda.] N

1962d Next British steps in the Indian Ocean. New Scient., 15: 468. [Announced plans for geophysical work, mainly seismic, in HMS 'Owen' in 1963.] N

1962e Watching the weather in the Indian Ocean. New Scient., 16: 244-245. [Announced the establishment of an International Meteorological Centre at Bombay.] N

1962f You can leave civilization behind you at Aldabra Atoll. Seychelles Annual, no.4, 25-27. T §

1963, 1966 Grammaire française à l'usage des écoliers des Seychelles. Victoria, Saint-Fidèle. 2 vol. ns u §

1964a International Indian Ocean Expedition. Oceanus, 10, 2-3. [A short summary of the plan.] LUO

1964b International Indian Ocean Expedition: cruises completed and planned 1959-1963. Oceanus, 10: 4-5. [A summary.] LUO

1964c International Indian Ocean Expedition: miscellaneous notes. Oceanus, 10: 28-29. LUO

1964d The turtles and tortoises of the Seychelles. Seychelles Annual, no.5, 23-27. T §

1966 USAF tracking station on Mahé. Seychelles Annual, 35-35. O §

1967 See "N.M.S."

1968 Attempts to use coir dust in the preparation of building slabs or hardboard. Publs trop.Prod.Inst.Lond., no.G.35, 1-4. [Recorded unsuccessful attempts.] T §

1969 News. Atoll Res.Bull., no.126, 1-3. [A brief report on phases 1-3 of the Royal Society Expedition to Aldabra, with a list of participating scientists.] N

1970 Itinerary of the cruising expedition. In: Forgotten islands of the Indian Ocean, 10-14. London, BOAC. [Article in an advertising brochure for a series of cruises; a good short account despite its purpose.] ns it §

1971 News. Atoll Res.Bull., no.148, 1-4. [Described phases 4-8 of the Royal Society Expedition to Aldabra, with a list of participating scientists.] N

APSTEIN, C.
1905 Salpen der Deutschen Tiefsee-Expedition. Valdivia Rep., 12: 1906, 245-289, 7 pl. Z

ARNELL, S.
1957 List of Hepaticae collected by A. Sörlin in the Seychelles 1955. Svensk bot.Tidskr., 51: 163-165. [Eleven species of liverwort from Mahé, including one new.] LUB

ARNOULT, J., BAUCHOT-BOUTIN, M.L. and ROUX-ESTEVE, R.
1958 Les poissons de l'île Aldabra: campagne océanographique de la 'Calypso' (mai-juin 1954). Annls Inst.océanogr. Monaco, 34, 47-90. [A systematic account.] LUO §

ARROW, G.J.
1922 Coleoptera, Erotylidae and Endomychidae from the Seychelles, Chagos and Amirantes Islands. Ann.Mag.nat.Hist., ser.9, 10: 73-83, 1 pl. [Collected by the Sladen Expedition.] LUC

ATTEMS, C.G.
1900 Dr. Brauer's Myriopoden-Ausbeute auf den Seychellen im Jahre 1895. Zool.Jb., 13: 133-171, 3 pl. [Described the twenty-three species then known.] N

1910 Myriopoden von Madagaskar, den Comoren und den Inseln Ostafrikas. Wiss.Ergebn.Reise Ostafr.1903-5, 3: pt.2, 73-115, 3 pl. [In VOELTZKOW and others 1906-1923.] N

ATWOOD, Alice.
1942 See BLAKE.

AUBER, J.
1955 Histoire de l'Océan indien. Tananarive, Société Lilloise d'Imprimerie. [Included geography and geology.] Ministère de l'Education, Paris

AUCHINLECK, G.C.
1921a La composition et l'usage des engrais ordinaires. Bull. Dep.Agric.Seychelles, no.1, 1-7. ns u §

1921b L'élevage du bétail aux Seychelles. Bull.Dep.Agric. Seychelles, no.2, 1-8. ns u §

1922a Notes sur la vanille à Praslin. Bull.Dep.Agric.Seychelles, no.3, 1-4. ns u §

1922b Règlements du concours pour jardins potagers. Bull.Dep. Agric.Seychelles, no.4. ns u

1922c Jardins écoles et les jardins des élèves. Bull.Dep. Agric.Seychelles, no.5. ns u

1922d L'agriculture aux Seychelles. Bull.Dep.Agric.Seychelles, nos.6-12, 1-38. ns u
Reprinted from Le Réveil seychellois by Imprimerie Réveil seychellois. ns u §

1922e Les pailles de chapeaux. Bull.Dep.Agric.Seychelles, no. 13. ns u

1922f Notes on nature study for use by teachers in the schools of the Colony. Bull.Dep.Agric.Seychelles, no.14, 1-24. ns u §

1922g Petit catéchisme sur les cocotiers à l'usage des planteurs. Bull.Dep.Agric.Seychelles, no.15, 1-86. ns u §

1922h Les cocotiers, la lumière et le sol. Bull.Dep.Agric. Seychelles, no.16. ns u

AURIVILLIUS, C.
1909 Lepidoptera, Rhopalocera und Heterocera von Madagaskar, der Comoren und den Inseln Ostafrikas: I. Wiss.Ergebn.Reise Ostafr.1903-5, 2: 309-348, 1 pl. [In VOELTZKOW and others 1906-1923.] N §

1922 Coleoptera (Cerambycidae) from the Seychelles Islands, Aldabra and Rodriguez. Ann.Mag.nat.Hist., ser.9, 10: 421-443, 2 pl. [Collected by the Sladen Expedition.] LUC

AUSTEN, E.E.
1920 The Percy Sladen Trust Expedition . . . . Diptera: Tabanidae. Bull.ent.Res., 11: 43-45. [Four species described, one new.] LUTM

BACON, E.V.
1943 See FOSTER.

BADCOCK, J.R.
1970 See FORSTER.

BAGNALL, R.S.
1921 On Thysanoptera from the Seychelles Islands and Rodriguez. Ann.Mag.nat.Hist., ser.9, 7: 257-293, 4 pl. [Mainly collected by the Sladen Expedition in 1908-1909.] LUC

BAILEY, D.
1944 List of flowering plants and ferns of Seychelles. Victoria, Clarion. [Arranged alphabetically by local name.] ns §
Second edition, 1961. Victoria, Saint-Fidèle. N §
Third edition, 1971, as: List . . . Seychelles with their vernacular names. Victoria, Government Printer. ns §

1962 The cowries of the Seychelles. Seychelles Annual, no.4, 20-24. T §

BAILEY, L.H.
1930 Binomials of certain palms: the case of Stevensonia. Gentes Herb., 2: 192-195, 438-441; 3: 115-116. [Discussed nomenclature and recommended consideration of horticultural records.] N

1942 Palmae sechellarum. With sections by VESEY-FITZGERALD, L.D.E.F. (5-8, 23-26, 32-34, 38-40, 40-42, 43-46, 48). Gentes Herb., 6: 1-48. N §

BAILEY, R.S.
1963 The birds of the western Indian Ocean. J.Seychelles Soc., no.3, 41-49. K §

1964 The International Indian Ocean Expedition. Ibis, 106: 140-141. [An interim report on birds seen on the cruise of RRS 'Discovery', June-November 1963.] N
Also in IIOE Repr. 2: 1966, 672.

1965 Cruise of RRS 'Discovery' in the Indian Ocean. Sea Swallow, 17: 52-56, 2 pl. [Reported counts of birds seen on the cruise.] N §
Also in IIOE Repr., 3: 1966, 525-531.

1966a Migrant land-birds in the Mediterranean and Red Seas and the Indian Ocean. Ibis, 108: 421-422. [Observations from RRS 'Discovery' in 1963 and 1964.] P

1966b Migrant waders in the Indian Ocean. Ibis, 109: 1967, 437-439. [Observations from RRS 'Discovery' in 1963 and 1964.] P
Also in IIOE Repr., 7: 1971, 167-169.

1967 The pelagic distribution of sea birds in the western Indian Ocean. Ibis, 110: 1968, 493-519. [Work on RRS 'Discovery' in 1963 and 1964. With a summary.] P
Also in IIOE Repr., 7: 1971, 787-813.

BAILEY, R.S., POCKLINGTON, R. and WILLIS, P.R.
1966 Storm-petrels Oceanodroma spp. in the Indian Ocean. Ibis, 110: 1968, 27-34. [With a summary.] P
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Also in IIOE Repr., 7: 1971, 779-786.

BAISSAC, J. de B.
1962 The scombroid fishes of Mascarene waters. Proc.Symp. scombroid Fishes, mar.biol.Ass.India., Mandapam Camp, ser.1, 185-186. N

BAKER, B.H.
1963 Geology and mineral resources of the Seychelles Archipelago. Mem.geol.Surv.Kenya, no.3, 1-140. [With a bibliography and four maps; few mineral resources found.] B §

BAKER, B.H. and MILLER, J.A.
1963 Geology and geochronology of the Seychelles Islands and the structure of the floor of the Arabian Sea. Nature, Lond., 199: 346-348. N
Also in IIOE Repr., 1: 1965, 665-670.

BAKER, J.G.
1874 Report on the Seychelles fern flora. Trans.R.Ir.Acad., 25: 1875, 509-518, 4 pl. [A full list to date.] LUZ

1875 List of Seychelles Myrtaceae, with descriptions of two new species. Proc.R.Ir.Acad., ser.2, 2: 160, 2 pl. [Eugenia, three species, and Barringtonia, three species.] LUC

1877 Flora of Mauritius and the Seychelles . . . . With sections on Palmae and Pandaneae by BALFOUR, I.B. and Orchideae by MOORE, S. le M. London, Reeve. N §
Reviewed by McNAB, W.R. in Nature, Lond., 17: 77-78. LUC

1894 Flora of Aldabra Islands. Kew Bull., 146-151. N §

BAKUN, A.
1966 See RYTHER.

BALFOUR, I.B.
1877a Palmae. In BAKER, J.G. 1877.

1877b Pandaneae. In BAKER, J.G. 1877.

BALLARD, F.
1966 Orchids of the Seychelles. Seychelles Annual, 36-38. O §

BALLE, S.
1964 Les loranthacées de Madagascar et des archipels voisins. Andansonia, 4: 106-141. [Included Aldabra and Seychelles species.] N

BALSS, H.
1911 Die Paguriden [of the German Deep-sea Expedition]. Valdivia Rep., 20: pt.1, 1912, 85-124, 5 pl. Z

1913 See DOFLEIN.

1914 Diagnosen neuer Macruren der 'Valdivia'-Expedition. Zool. Anz., 44: 592-599. LUZ

1920 Macrura der Deutschen Tiefsee-Expedition: I. Palinura, Astacura and Thalassinidea; II. Natantia, Teil A. Valdivia Rep., 20: pt.2, 1925, 185-315, 11 pl. Z

1926 Macrura der Deutschen Tiefsee-Expedition: III. Natantia, Teil B. Valdivia Rep., 23: 1927, 245-275, 1 pl. Z

1933 Beiträge zur Kenntnis der Gattung Pilumnus (Crustacea Dekapoda) und verwandter Gattungen. Capita zool., 4: pt.3, 1-47, 7 pl. [Several Seychelles species described.] N

BAMFORD, Edith E.
1911 Pelagic actiniarian larvae [of the Sladen Expedition]. Trans.Linn.Soc.Lond.(Zool.), 15: 1912, 395-406, 2 pl. [In GARDINER, J.S. and others 1907-1936.] N §

BANKS, L.
1840 The Séchelles. Port Louis. ns u

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1970 Seychelles: an economic survey. London, Barclays Bank DCO. [A short factual summary. Included also BIOT.] C §

1971 Barclays overseas survey 1971: a survey of trade and economic conditions during 1970 . . . . London, Barclays Bank DCO. [A short factual summary of Seychelles on 79-80.] LUA

BARKLY, Fanny A.

[1897] From the tropics to the North Sea. London, Roxburghe. [Five years in the Seychelles Islands, 1-121.] Bodleian Library, Oxford §

BARKLY, Sir H. and WARD, S.

1864 Letters . . . relative to the coco-de-mer. J.Linn.Soc. (Bot.), 9: 1867, 118-120. [Recommended measures for conservation.] LUB

BARNACLE, G.A.S.

1962 The land and freshwater shells of the Seychelles. J. Seychelles Soc., no.2, 53-57. [Included Aldabra, Amirantes, Coetivy, Cosmoledo and Farquhar.] K §

1967 Note on a streptaxid from Seychelles Imperturbatia levieuxi (Nevill and Nevill). J.Conch., Lond., 26: 1971, 386-387. [Collected by the Bristol University Expedition on Silhouette.] LUM §

BARNARD, J.L.

1961 Gammaridean Amphipoda [of the Danish Deep-sea Expedition]. Galathea Rep., 5: 23-128. N

BARNARD, K.H.

1937 Amphipoda [of the John Murray Expedition]. Mabahiss Rep., 4: 131-201. N

1964 The terrestrial Isopoda and Amphipoda of the Mascarene Islands. Bull.Maurit.Inst., 6: pt.1, 49-60. [Included Chagos and Seychelles species.] N §

BARNES, H.F.

1939 Gall midges (Cecidomyiidae) associated with coffee. Revue Zool.Bot.afr., 32: 324-336. [Megommata seychelli on 334-335.] N

BARNES, J., BELLAMY, D.J., DREW, E.A., JONES, D.J., LYTHGOE, J.N. and WHITTON, B.A.

1969 Sublittoral reef phenomena of Aldabra. Nature, Lond., 225: 1970, 268-269. [Results from transects levelled by SCUBA divers in phase 6 of the Royal Society Expedition.] LUC

BARNES, J., BELLAMY, D.J., JONES, D.J., WHITTON, B.A., DREW, E.A., KENYON, L., LYTHGOE, J.N. and ROSEN, B.R.

1970 Morphology and ecology of the reef front of Aldabra. Symp. zool.Soc.Lond., no.28, 1971, 87-114. [In STODDART, D.R. and YONGE (eds.). Results of a systematic survey by SCUBA diving. With a synopsis, and a provisional check list of corals collected during phase 6 of the Royal Society Expedition.] LUZ §

BARON, R.
1889 Notes on the geology of Madagascar: with an appendix on the fossils by NEWTON, R.B. Q.Jl geol.Soc.Lond., 45: 305-339. Z

BARROS. See De BARROS.

BASILEWSKY, P.
1970 Les coléoptères Carabidae de l'île d'Aldabra (Océan indien). Annls Soc.ent.Belg., 106: 211-222. [Eighteen species known. With a useful map on 212.] N

BATES, J.D.
1951 Frigate Island. Corona, 3: 257-258. C §

BATY, S.C.E.
1895 Report on the Aldabra group of islands. Victoria, Crown Lands Department. [Aldabra, Assumption, Astove and the Cosmoledo group.] C §

BAUCHOT, Marie-Louise.
1959 Etudes des larves leptocephales du groupe Leptocephalus lanceolatus Strömman et identification à la famille des Serrivomeridae. Dana Rep., 9: no.48, 1-148, 2 pl. Z

BAUCHOT-BOUTIN, M.L.
1958 See ARNOULT.

BAUER, M.
1897a Beiträge zur Geologie der Seyschellen. Sber.Ges.Beförd. ges.Naturw.Marburg, 1-20. N

1897b Ueber Laterit, insbesondere den von den Seyschellen. Sber.Ges.Beförd.ges.Naturw.Marburg, 122-148. N

1898 Beiträge zur Geologie der Seychellen, insbesondere zur Kenntnis des Laterits. Neues Jb.Min.Geol.Paläont., 2: 163-219, 2 pl. N

1911 Geologie und Ethnographie [of East Africa etc.]. Wiss Ergebn.Reise Ostafr.1903-5, 1: pt.2, 1-89. [In VOELTZKOW and others 1906-1923. Aldabra on 16.] N

BAUHIN, J. and CHERLER, J.H.
1619 Historiae plantarum generalis novae . . . prodromus. [According to FAUVEL, A.A. 1915, contained the first known drawing of two separated halves of a coco-de-mer nut.] ns it: in B catalogue

BAX, A. (ed.).
1938 The Mauritius almanac and commercial handbook for 1937-38. Port Louis, General Printing and Stationery Co. [Other islands in the region described on 5-9.] G

BAYNE, C.J., COGAN, B.H., DIAMOND, A.W., FRAZIER, J., GRUBB, P., HUTSON, A.M., POORE, M.E.D., STODDART, D.R. and TAYLOR, J.D.
1970a Geography and ecology of Cosmoledo Atoll. Atoll Res. Bull., no.136, 37-56. [In STODDART, D.R. (ed.) 1970.] NL §

1970b Geography and ecology of Astove. Atoll Res.Bull., no.136, 83-99. [In STODDART, D.R. (ed.) 1970.] NL §

BE, A.W.H. and TOLDERLUND, D.S.
1967 Distribution and ecology of living planktonic Foraminifera in surface waters of the Atlantic and Indian Oceans. In FUNNELL and RIEDEL (eds.), 105-149. [With a summary.]

BEAMISH, A.
1967 Saving Aldabra. Listener, Lond., 78: 605-606. P

1968a Aldabra reprieved. Animals, 10: 548-553. N §

1968b Cousin Island must be saved. Birds, 2: 90-92. NL §

1968c Observations on a breeding pair of paradise flycatchers on La Digue. J.Seychelles Soc., no.6, 17-19. [Seychelles.] K §

1969 Visit to Cousin Island. Oryx, 10: 193. [Bought by ICBP in 1968.] LUZ §

1970 Aldabra alone. London, Allen and Unwin. [Visited in 1967 with Lionnet. A plea for conservation. Contained an appendix by BOURNE, W.R.P.] Bebington Public Library §

BECCARI, O. and PICHI-SERMOLLI, R.E.G.
1954 Subfamiliae arecoidearum palmae gerontogeae: tribuum et generum conspectus. Webbia, 11: 1956, 1-187. N

BEHNING, A.
1914 Amphipoda der Deutschen Tiefsee-Expedition: I. Fam. Vibiliidae Claus 1872. Valdivia Rep., 19: pt.2, 1925, 477-500. Z

BEHNING, A. and WOLTERECK, R.
1912 Achte Mitteilung über die Hyperiden der 'Valdivia'-Expedition, insbesondere über die Vibiliden. Zool.Anz., 41: 1913, 1-11. LUZ

BEIER, M.
1940 Die Pseudoscorpionidenfauna der landfernen Inseln. Zool. Jb., 74: 161-192. [Three Aldabra, one Chagos and nine Seychelles species described.] N

BELCHER, Sir E.
1843 Narrative of a voyage round the world, performed in HMS 'Sulphur' during the years 1836-1842 . . . . London, Colburn. 2 vol. [Seychelles in 2: ch.8.] Z

BELJAEV, G.M. and VINOGRADOV, M.E.
1961 Zoological studies in the 31st cruise of RV 'Vityaz'. Zool.Zh., 40: 303-308. [In Russian.] NL
Also in IIOE Repr., 2: 1966, 183-188. [English title on vii.]

BELJAEV, G.M. and VINOGRADOVA, M.G.
1961 Quantitative distribution of bottom fauna in the northern half of the Indian Ocean. Dokl.Akad.Nauk SSSR, 138: 1191-1194. [In Russian.] NL
Also in IIOE Repr., 2: 1966, 169-172. [English title on vii.]

BELJAEVA, N.V.
1964 Distribution of planktonic Foraminifera in the water and on the floor in Indian Ocean. Trudȳ Inst.Okeanol., 68: 12-83. [In Russian.] NL
Also in IIOE Repr., 3: 1966, 862-933. [With a very brief titled abstract in English.]

BELL, F.J.
1884 Echinodermata [of the voyage of the 'Alert']. Alert Rep., 509-512, 1 pl. Z

1908 Report on the Echinoderma (other than holothurians) collected by Mr. J.Stanley Gardiner in the western parts of the Indian Ocean. Trans.Linn.Soc.Lond.(Zool.), 13: 1909, 17-22, 1 pl. [In GARDINER, J.S. and others 1907-1936.] N §

BELLAMY, D.J.
1969 See BARNES, J.

1970 See BARNES, J.

BELLAMY, D.J., DREW, E.A., JONES, D.J. and LYTHGOE, J.N.
1969 Aldabra: a preliminary report on the work of phase 6 of the Royal Society Expedition. Underwat.Ass.Rep., 4: 100-104. [A study of the sublittoral reef front using transects. With a summary.] N

BELLING, L.N.

1971 Seychelles: islands of love, îles d'amour. Boulogne-Billancourt, Delroisse. [A colour album. with a short geographical and historical introduction in English and French, of photographs of plants and animals by L.N.Belling, G.de la Bergerie, R. Lloyd-Kirk, J.L. de Sauverzac and C.Zuber.] C §

BELOUSOV, I.M.

1961 Thirty-first cruise of RV 'Vityaz'. Okeanologia, 1: 319-325. [In Russian.] NL
Also in IIOE Repr., 1: 1965, 815-821. [English title on xvi.]

1964 On the bottom topography of the north-western Indian Ocean. Int.geol.Congr., sess.22, group 1. ns tt nl: WLSP
Abstracted in ROY (ed.), Group discussions, 5. [Reviewed work on RV 'Vityaz', 'Vema', 'Argo' and 'Owen'. Distinguished seven basins including Comor, Maskaren and Amirant.] N

BELTZ, R.E.

1953 Young specimens of Testudo gigantea daudinii in Southern California. Herpetologica, 8: 178. [Reported the arrival of two specimens from Aldabra.] N §

1954 Miscellaneous observations on captive Testudininae. Herpetologica, 10: 45-47. [Included one from Aldabra.] N §

1958 Eating habits of some captive Testudines. Herpetologica, 13: 272. [Commented on the sensitivity of T.gigantea to tomato fruits.] N §

1960 Testudo gigantea. Bull.Philad.Herpet.Soc., 8: pt.6, 3-. [A letter to the editor.] ns tt nl

BENDIRE, C.

1894 Description of nests and eggs of some new birds, collected on the island of Aldabra . . . by Dr. W.L.Abbott. Proc. U.S.natn.Mus., 17: 1895, 39-41. [Four species described.] LUZ

BENEDICT, B.

1963 Dependency and development in the Seychelles. Social Serv. Q., 37: 9-12, 28. [Description and discussion of factors influencing apathy of the people.] O §

1966 People of the Seychelles. London, HMSO. [A study of the domestic group and its place in Seychelles society.] O §
Third edition, 1970. ns

1967 The equality of the sexes in the Seychelles. In: Social organization: essays presented to Raymond Firth, edited by M.Freedman, 43-63. London, Cass. Preston Public Library §

BENSON, C.W.

1960a The birds of the Comoro Islands: results of the British Ornithologists' Union Centenary Expedition 1968. Ibis, 103b: 5-106, 4 pl. [Contained frequent references to distribution throughout the region.] N

1960b Les origines de l'avifaune de l'archipel des Comores. Mém.Inst.scient.Madagascar, ser.A, 14: 173-204, 6 pl. NL

1962 Notes on some specimens mainly from Aldabra. Bull.Br.Orn. Club, 83: 13-15. [A fresh look at some of the bird specimens in W.L.Abbott's collection reported on by RIDGWAY 1895.] N

1967 The birds of Aldabra and their status. Atoll Res.Bull., no.118, 63-111. [In STODDART, D.R. (ed.) 1967. With a systematic list.] N §

1968 The white-eye Zosterops maderaspatana (Linn.) of Menai Island, Cosmoledo Atoll. Bull.Br.Orn.Club, 89: 1970, 24-27. [Suggested a new subspecies.] NL §

1969 The systematic status of the form of Streptopelia picturata on Diego Garcia. Bull.Br.Orn.Club, 90: 1970, 33-35. NL §

1970a See STODDART, D.R. and BENSON.

1970b Land (including shore) birds of Cosmoledo. Atoll Res. Bull., no.136, 67-81. [In STODDART, D.R. (ed.) 1970.] NL §

1970c Land (including shore) birds of Astove. Atoll Res.Bull., no.136, 115-120. [In STODDART, D.R. (ed.) 1970.] NL §

1970d See STODDART, D.R., BENSON and PEAKE.

1970e An introduction of Streptopelia picturata into the Amirantes. Atoll Res.Bull., no.136, 195-196. [In STODDART, D.R. (ed.) 1970. Two specimens collected by I.S.C. Parker on St. Joseph Atoll.] NL §

1970f Indian Ocean sunbirds. Animals, 12: 496-497. [Nectarinia dussumieri in Seychelles and subspecies of N. sovimanga in Aldabra group.] N

1970g The Cambridge collection from the Malagasy region. Bull. Br.Orn.Club, 91: 1971, 1-7. [Included several species from the area.] NL §

BENSON, C.W. and PENNY, M.J.

1968 A new species of warbler from the Aldabra Atoll. Bull.Br. Orn.Club, 88: 102-108. [Nesillas aldabranus.] N §

1969 The land birds of Aldabra. Phil.Trans.R.Soc., ser.B, 260: 1971, 417-527, 2 pl. [In WESTOLL and STODDART, D.R. (org.).] LUC §

BENSON, C.W. and ROUX, F.

1967 Deux records méconnus des Seychelles. Oiseau, Paris, 37: 144-145. [Glareola maldivorum Fischer and Cuculus canorus L.] N

BERGER, L.A.

1962 Hesperiidae récoltés aux Seychelles. Lambillionea, 62: 19-20. [Report on two species collected by H. Legrand.] N §

BERGROTH, E.

1892 Mission scientifique de M. Ch.Alluaud aux îles Séchelles: hétéroptères. Revue Ent., 12: 1893, 197-209. N

BERINGER, G.M.

1892 Some commercial vanillas. Am.J.Pharm., 64: 289-294. [Included the Seychelles variety.] Manchester University Medical Library §

Also as: Some vanillas of commerce. Pharm.J., ser.3, 23: 9-11. LUC

Reprinted in Kew Bull., 212-215. N

BERIO, E.

1956 Eteroceri raccolti dal Dr.Carlo Prola durante la spedizione alle isole dell'Africa orientale, con descrizione de specie nuovo. Boll.Soc.ent.ital., 86: 82-87. [Included species from Aldabra and Cosmoledo.] N

1959 Descrizione di tre specie nuovo di Noctuidae prevenienti dall'isola di Aldabra e da Nairobi (Kenya). Boll.Soc.ent. ital., 89: 11-12. N §

1962 Diagnosi di alcune Noctuidae delle isole Seicelle e Aldabra. Annali Mus.civ.Stor.nat.Giacomo Doria, 73: 172-180. [Three new genera, seven species and a subspecies.] N

BERKELEY, H. and CALDWELL, J.

1859 Report of the Commissioners appointed by HE the Governor to visit the Smaller Dependencies of Mauritius, and to enquire into the condition of the labourers employed therein. Port Louis, [Government Printer]. [Visited Diego Garcia.] ns it: Mauritius Register, 1859-1860 PR

Von BERLEPSCH, H.G.

1898 Systematische Verzeichnis der von Dr. Alfred Voeltzkow in Ost-Afrika und auf Aldabra (Indischer Ocean) gesammelten Vogelbälge: II. Vögel von der Insel Aldabra. Abh.senckenb. naturforsch.Ges., 21: 489-496. [In VOELTZKOW and others 1897-1905.] N

BERLIOZ, J.

1946 Oiseaux de la Réunion. Faune Emp.fr., 4: 1-83. [Contained some species occurring also in Aldabra and Seychelles.] N

1960 Une énigme historico-géographique: les perroquets des îles Mascareignes. C.r.somm.Séanc.Soc.Biogéogr., 327: 78-83. [Discussed the replacement of native parrots by introduced species. Included Seychelles.] N

BERNARD, F. and LECAL, J.

1960 Plancton unicellulaire récolté dans l'Océan indien par le 'Charcot' (1950) et le 'Norsel' (1955-56). Bull.inst. océanogr.Monaco, no.1166, 1-59. [Found a predominance of Coccolithophoridae, followed by Myxophyceae and Dinoflagellata. Diatoms were absent.] LUO

BERNARD, H.M.

1896 The genus Turbinaria, the genus Astraeopora. In: Catalogue of the madreporarian corals, 2: iv plus 1-106, 33 pl. London, Trustees of the British Museum. N

1897 The genus Montipora, the genus Anacropora. In: Catalogue of the madreporarian corals, 3: vii plus 1-192, 34 pl. London, Trustees of the British Museum. N

1905 The family Poritidae: II. The genus Porites, pt.1. In: Catalogue of the madreporarian corals, 5: vii plus 1-303, 35 pl. London, Trustees of the British Museum. N

BERNARDI, G.

1959 Biogéographie et spéciation des Pieridae de Madagascar et de Socotra. Colloques int.Cent.natn.Rech.scient., no.94, 1961, 273-281. [Included Aldabra.] S §

1968 Une nouvelle sous-espèce d'Eurema floricola Boisduval (Lep. Pieridae). Bull.Soc.ent.Fr., 73: 193-194. [From Aldabra.] N §

BERNEAUD. See De BERNEAUD.

BERNHAUER, M.

1920 Results of Dr.E.Mjöberg's Swedish scientific expeditions to Australia, 1910-1913: XXII. Staphylinidae. Ark.Zool., 13: no.8, 1-27. [Phloeonomus singularis Kr. on 5.] LUZ

1921 Coleoptera, Staphylinidae [of the Sladen Expedition]. Trans.Linn.Soc.Lond.(Zool.), 18: 1922, 165-186. [In GARDINER, J.S. and others 1907-1936.] N §

BERNHAUER, M. and SCOTT, H.

1931 Entomological expedition to Abyssinia, 1926-27: Coleoptera Staphylinidae: systematic report and introduction, with biogeographical and ecological remarks. Proc.Linn.Soc. Lond., sess.1930-1931, 71-73. G

BERTELSEN, E.

1951 The ceratioid fishes: ontogeny, taxonomy, distribution and biology. Dana Rep., 7: no.39, 1-276, 1 pl. Z

BERTELSEN, E. and MARSHALL, N.B.

1956 The Mirripinnati, a new order of teleost fishes. Dana Rep., 8: no.42, 1-34, 1 pl. Z

BERTIN, L.

1934 Les poissons apodes appartenant au sous-ordre lyomères [of the 'Dana' expeditions]. Dana Rep., 1: no.3, 1-56, 2 pl. Z

1937 Les poissons abyssaux du genre Cyema Günther (anatomie, embryologie, bionomie). Dana Rep., 1: no.10, 1-30. Z

1938 Formes nouvelles et formes larvaires de poissons apodes appartenant au sous-ordre lyomères. Dana Rep., 3: no.15, 1-26, 2 pl. Z

BESCHERELLE, E.

1878 Florule bryologique de la Réunion et des autres îles austro-africaines de l'Océan indien. Annls Sci.nat.Bot., ser.6, 9: 291-380; 10: 1880, 233-332. N

1891 Selectio novorum muscorum. J.Bot., Paris, 5: 142-148. [Aerobryum crispicuspe on 145.] N

BETTS, F.N.

1940 See VESEY-FITZGERALD.

BEZRUKOV, P.L.

1961a Investigations of the Indian Ocean in the 33rd cruise of the RV 'Vityaz'. Okeanologia, 1: 745-753. [In Russian.] NL

Also in IIOE Repr., 1: 1965, 823-831. [English title on xvi.]

1961b Investigation of bottom sediments in the northern Indian Ocean. Okeanol.Issled., no.4, 76-90. [In Russian. Results of RV 'Vityaz'.] NL

Also in IIOE Repr., 1: 1965, 522-536. [With an untitled abstract in English; English title on xv.]

1963a Investigations of the Indian Ocean in the 35th cruise of the RV 'Vityaz'. Okeanologia, 3: 540-549. [In Russian. Visited Chagos.] NL

Also in IIOE Repr., 1: 1965, 832-841. [English title on xvi.]

1963b Studies conducted by the 'Vityaz' during the International Indian Ocean Expedition programme. Vest.Akad.Nauk SSSR, 33: 97-104. [In Russian, with no abstract; title as translated by I.M.P.] S

1964a Sedimentation in the northern and central parts of the Indian Ocean. Int.geol.Congr., sess.22, group 3, 41-51. ns tt nl: WLSP

Abstracted in ROY (ed.), Group discussions, 14. [Work of RV 'Vityaz' in 1959-1962. Five types of sediment distinguished.] N

1964b Sediments of the northern and central Indian Ocean. Trudy Inst.Okeanol., 64: 182-201. [In Russian. Results of RV 'Vityaz'.] NL

Also in IIOE Repr., 1: 1965, 728-749. [With an untitled summary in English; English title on xvi.]

BEZRUKOV, P.L., KRYLOV, A.Y. and CHERNYSHEVA, V.I.

1966 Petrography and the absolute age of the Indian Ocean floor basalts. Okeanologia, 6: 261-266. [In Russian. Results of RV 'Vityaz', 1959-1962. Age of bottom volcanic rocks as found by a potassium-argon method was about sixty million years.] NL

Also in IIOE Repr., 4: 1967, 811-816. [With a titled summary in English.]

BEZZI, M.

1923 Diptera: Bombyliidae and Myiodaria (Coenosiinae, Muscinae, Calliphorinae, Sarcophaginae, Dexiinae, Tachininae), from the Seychelles and neighbouring islands. With an introduction by SCOTT, H. Parasitology, 15: 75-102. [Final report on Diptera collected in both visits of the Sladen

Expedition in HMS 'Sealark', 1905 and 1908-1909.] LUTM

BIEN, G.S., RAKESTRAW, N. and SUESS, H.E.
1965 Radiocarbon in the Pacific and Indian Oceans and its relation to deep water movements. Limnol.Oceanogr., 10: suppl., R25-R37. [With an abstract.] LUO
Also in IIOE Repr., 5: 1-68, 647-659.

BIGOT, L.
1962 Les Pterophoridae des îles Seychelles. Bull.Soc.ent.Fr., 67: 79-88. N §

BILLARDIERE. See De LABILLARDIERE.

BIRCH, F.S. and HALUNEN, A.J., jr.
1965 Heat flow measurements in the Atlantic Ocean, Indian Ocean, Mediterranean Sea and Red Sea. J.geophys.Res., 71: 1966, 583-586. LUO
Also in IIOE Repr. 4: 1967, 827-830.

BLACKBURN, C.A.
1878 Quelques courtes descriptions des oiseaux de Praslin. Trans.R.Soc.Arts Sci.Maurit., ser.B, 12: 1883, 125-130. K

BLACKMAN, R.A.A.
1965 Bristol University Seychelles Expedition: VII. Biological control. Animals, 8: 72-74. [Reported the failure of an attempt to control rats in Seychelles by introducing the Kenya barn owl.] N §

1968 See GAYMER.

BLACKMAN, R.A.A. (ed.)
1966 Bristol Seychelles Expedition 1964-65. Bristol, Bristol University Expedition Society. ns it: BLACKMAN and others §

BLACKMAN, R.A.A. and PINHEY, E.C.G.
1967 Odonata of the Seychelles and other Indian Ocean island groups, based primarily on the Bristol University expedition of 1964-1965. Arnoldia, 3: no.12, 1-38. [Reviewed the dragonfly faunas of Aldabra, Chagos and Seychelles groups.] N §

BLACKMAN, R.A.A. and others.
[1968] Bristol Seychelles Expedition 1964-65. World Wildlife Project no.118. Bristol, Bristol University Expedition Society. Mimeographed. [A list of reports and published articles. Visited Aldabra also.] ns u §

BLACKWALL, J. and CAMBRIDGE, O.P.
1876 A list of spiders captured in the Seychelles by Professor E.Perceval Wright, with descriptions of species supposed to be new to arachnologists. Proc.R.Ir.Acad., ser.2, 3: 1883, 1-22, 2 pl. LUC

BLAKE, S.F. and ATWOOD, Alice
1942 Geographical guide to floras of the world: an annotated list with special reference to useful plants and common plant names. Misc.Publs U.S.Dep.Agric., no.401. 2 pt. [Aldabra, Chagos and Seychelles in pt. 1.] N

BLANC, C.P.
1971 Les reptiles de Madagascar et des îles voisines. Annls Univ.Madagascar (Sci.), no.8, 95-178. [Dealt with Aldabra, Amirantes, Coetivy, Farquhar and Seychelles, as well as with Comoros, Europa, Glorieuses, Madagascar and Mascarenes. With an abstract and a long bibliography.] N §

BLANFORD, H.F.
1874 On the age and correlations of the plant-bearing series of India, and the former existence of an Indo-Oceanic continent. Q.Jl geol.Soc.Lond., 31: 1875, 519-542, 1 pl. [With discussion.] G

BLANFORD, W.T.
1890 Anniversary address of the President [of the Geological Society of London]. Q.Jl geol.Soc.Lond., 46: 43-110. [Presented evidence for a former land bridge between Madagascar and India.] Z

BLASIUS, R.
1887 See FINSCH.

BLATTER, E.
1910 History of the sea cocoa-nut (Lodoicea sechellarum, Labill.). J.Bombay nat.Hist.Soc., 925-937. NL §

1926 The palms of British India and Ceylon. London, Oxford University Press. [Lodoicea seychellarum on 213-245, with a historical account of the literature. Other Seychelles palms on 413-438.] N

BLEEKER, P.
1868-1877 See POLLEN.

BOCKELER, O.
1879 Phanerogamae: I. Cyperaceae [of the Decken expeditions]. Deckens Reisen, 3: pt.3, Botanik, 73-74. Z

BOETTGER, O.

1896 Neue Kriechtiere (Scelotes, Arthroleptis) von den Seychellen. Zool.Anz., 19: 349-351. LUZ

1913 Reptilien und Amphibien von Madagaskar, den Inseln und dem Festland Ostafrikas. Wiss.Ergebn.Reise Ostafr.1903-5, 3: 269-375, 8 pl. [In VOELTZKOW and others 1906-1923. Aldabra species on 333-336. Included a full list of species from the region; all were reptiles.] N

BOGOROV, V.G., BORDOVSKY, O.K. and VINOGRADOV, M.E.

1966 Biogeochemistry of the oceanic plankton: the distribution of some chemical components of the plankton in the Indian Ocean. Okeanologia, 6: 314-325. [In Russian.] NL

Also in IIOE Repr., 4, 1967, 474-485. [With a titled summary in English.]

BOGOROV, V.G. and RASS, T.S.

1960 On productivity and the prospects of fishing in the waters of the Indian Ocean. Okeanologia, 1: 1961, 107-109. [In Russian; title as translated by I.M.P.] NL

BOGOROV, V.G. and VINOGRADOV, M.E.

1961 Some features of plankton biomass distribution in the surface water of the Indian Ocean during the winter of 1959-60. Okeanol.Issled., no.4, 66-71. [In Russian.] NL

Also in IIOE Repr., 2: 1966, 190-195. [With an untitled abstract in English; English title on viii.]

BOJER, W.

1835 [Letter from Agalega addressed to Mr. Blackburn.] Trans.R. Soc.Arts Sci.Maurit., ser.B, 5: 1871, 132-140. [Communicated with comments by BOUTON 1871. Contained a description of the island and a list of its plants.] N §

1837 Hortus mauritianus: énumération des plantes exotiques et indigènes qui croissent à l'île Maurice, déposées d'après la méthode naturelle. Port Louis, Mamarot. [Included Agalegas and Diego Garcia.] N

1841 [Plusieurs espèces nouvelles de plantes recueillies dans ses voyages à Madagascar et aux îles Comores.] Reproduced by L.Bouton. Rap.ann.Soc.Hist.nat.Ile Maurice, 11: 37-48. [Calpidia macrophylla from Agalegas on 42-43; Boerhaavia insularis from Agalegas, Diego Garcia and Seychelles on 43-44.] University of Mauritius §

Extracted as: Descriptions de diverses plantes nouvelles de Madagascar, des îles Comores et de l'île Maurice. Annls Sci.nat.Bot., ser.2, 18: 1842, 184-192. N

BOLIVAR, I.

1894 Mission scientifique de M. Ch.Alluaud aux îles Séchelles: orthoptères. Annls Soc.ent.Fr., 64: 1895, 369-386. N

1912 Orthoptera: Acrydiidae, Phasgonuridae, Gryllidae [of the Sladen Expedition]. Trans.Linn.Soc.Lond.(Zool.), 15: 263-292, 2 pl. [In GARDINER, J.S. and others 1907-1936. In French. See also BOLIVAR 1924b.] N §

1924a Orthoptera Dictyoptera (Blattidae and Mantidae) of the Seychelles and adjacent islands. Ann.Mag.nat.Hist., ser.9, 13: 313-358. [Collected by the Sladen Expedition.] LUC

1924b Supplement to Acrydiidae, Phasgonuridae and Gryllidae from the Seychelles Islands. Ann.Mag.nat.Hist., ser.9, 13: 359. [See BOLIVAR 1912.] LUC

BOLIVAR, I. and FERRIERE, C.

1912 Orthoptera, Phasmidae of the Seychelles. Trans.Linn.Soc. Lond.(Zool.), 15: 293-300. [In GARDINER, J.S. and others 1907-1936.] N §

BONAME, P.

1909 Notes sur la composition du cocotier. Bull.Stn agron. Maurice, no.19, 1-35. [Contained analyses of coconut palms from Farquhar and Seychelles.] ns tt nl: WLSP §

BONNET, P.

1945 Bibliographia araneorum . . . jusqu'en 1939. Toulouse, Dauladoure. 3 vol., 2: in 5 pt. [Alphabetical list of authors' works, followed by several analytical indexes including systematic. Araneida only.] N

BONNETARD, N.G.

1921 See SEYCHELLES: GOVERNMENT.

BORDOVSKY, O.K.

1961 On the chemistry of the bottom sediments of the Indian Ocean. Okeanol.Issled., no.4, 91-99. [In Russian.] NL
Also in IIOE Repr. 1: 1965, 537-545. [With an untitled abstract in English; English title on xv.]

1964 On the characteristics of the organic matter in the sediments of the Pacific and Indian Oceans. In: Environment and processes of petroleum formation, 100-129. Moscow, Nauka. [In Russian.] ns u
Also in IIOE Repr. 3: 1966, 832-861. [English title on ix.]

1966 See BOGOROV.

BORGEN, C.

1879 Dr.Albrecht Roscher's magnetische Beobachtungen in der ostafrikanischen Küste in den Jahren 1858 und 1859. Deckens Reisen, 3: pt.3, 35-48. [Appendix to KERSTEN 1879a. Especially 48.] Z

BORMANS. See De BORMANS.

BORRADAILE, L.A.

1907a Land and freshwater Decapoda [of the Sladen Expedition]. Trans.Linn.Soc.Lond.(Zool.), 12: 63-68. [In GARDINER, J.S. and others 1907-1936.] N §

1907b Stomatopoda from the western Indian Ocean. Trans.Linn. Soc.Lond.(Zool.), 12: 209-216, 1 pl. [In GARDINER, J.S. and others 1907-1936.] N §

1909 Penaeidea, Stenopidea and Reptantia from the western Indian Ocean. Trans.Linn.Soc.Lond.(Zool.), 13: 1910, 257-264, 1 pl. [In GARDINER, J.S. and others 1907-1936.] N §

1910 On the land and amphibious Decapoda of Aldabra. Trans.Linn. Soc.Lond.(Zool.), 13: 405-409. [In GARDINER, J.S. and others 1907-1936.] N §

1915 Notes on carides. Ann.Mag.nat.Hist., ser.8, 15: 205-213. [Prawns from the Indo-Pacific region.] LUC

1916a On the Pontoniinae [of the Sladen Expedition]. Trans.Linn. Soc.Lond.(Zool.), 17: 1917, 323-396, 6 pl. [In GARDINER, J.S. and others 1907-1936.] N §

1916b On carides from the western Indian Ocean. Trans.Linn.Soc. Lond.(Zool.), 17: 1917, 397-412, 2 pl. [In GARDINER, J.S. and others 1907-1936.] N §

BORY de SAINT VINCENT, J.B.G.M., Baron.

1804 Voyage dans les quatre principales îles des mers d'Afrique . . . 1801 et 1802 . . . . Paris, Buisson. 3 vol. [Seychelles in 1: 245-252.] G

Voyage to, and travels through the four principal islands of the African seas . . . 1801 and 1802 . . . . [Translator not named.] In: A collection of modern and contemporary voyages and travels, edited by Sir.R.Phillips, 2:. London, Phillips, 1805. [Seychelles on 200.] G

BOSCHMA, H.

1948 Notes on specimens of Millepora in the collection of the British Museum. Proc.zool.Soc.Lond., 119: 1949, 661-672, 2 pl. [Included a specimen from African Island on 668, two from Diego Garcia (collected by G.C.Bourne) on 665 and 669 and two from Seychelles on 663 and 669.] LUZ

1951 Some smaller whales. Endeavour, 10: 131-135. [Mesoplodon densirostris from Seychelles on 132.] LUTM

1957 List of the described species of the order Stylasterina. Zool.Verh., Leiden, no.33, 1-72. [Included seven species collected by the Sladen Expedition in Chagos, Coetivy, Farquhar, Providence and Seychelles.] NL

1959 Revision of the Indo-Pacific species of the genus Distichopora. Bijdr.Dierk., 29: 121-171, 16 pl. [Included two species from Chagos, one from Providence and one from Seychelles, collected by J.S.Gardiner.] LUC

Van BOSSE, A.W.
1913 Marine Algae, Rhodophyceae of the 'Sealark' expedition, collected by Mr.J.Stanley Gardiner, MA. Trans.Linn.Soc. Lond.(Bot.), 8: 105-142, 3 pl. N
Reprinted in Trans.Linn.Soc.Lond.(Zool.), 16: 1914, 269-306, 3 pl. [In GARDINER, J.S. and others 1907-1936.] N §

BOUCHERAT, A.
1888 Report on Peros Banhos and Diego Garcia. Port Louis. ns it: STODDART, D.R. 1971g

BOUFFE, G.
1913 Lettres aux propriétaires de l'île Agaléga. Port Louis, [publisher not named]. ns u §

BOUGHTON, G.A.
1970 Tourism tomorrow in Seychelles. Victoria, Government Printer. [A short information pamphlet by the government's tourism adviser.] C §

BOUILLON, J.
1967 Revision de la famille des Ptilocodiidae avec la description d'un nouveau genre et d'une nouvelle espèce. Bull.Acad.r. Belg.Cl.Sci., ser.5, 53: 1106-1131, 3 pl. [Hydrichthella epigorgia and Thecocodium brieni on gorgonarians from Mahé.] N §

1968 Une mission scientifique belge à l'archipel des Seychelles. Africa-Tervuren, 14: 98-102. N §

BOUILLON, J. and HOUVENAEGHEL-CREVECOEUR, Nadine.
1970 Etude monographique du genre Heliopora De Blainville (Coenothecalia-Alcyonaria-Coelentrata). Annls Mus.r.Afr. cent.Sér.8vo (Zool.), no.178, 1-83, 12 pl. NL §

BOULENGER, G.A.

1908 A list of the freshwater fishes, batrachians and reptiles obtained by Mr.J.Stanley Gardiner's expedition to the Indian Ocean. Trans.Linn.Soc.Lond.(Zool.), 12: 291-300, 1 pl. [In GARDINER, J.S. and others 1907-1936.] N §

1911 List of the batrachinas and reptiles obtained by Prof.Stanley Gardiner on his second expedition to the Seychelles and Aldabra. Trans.Linn.Soc.Lond.(Zool.), 14: 375-378. [In GARDINER, J.S. and others 1907-1936.] N §

1915 A list of the snakes of Madagascar, Comoro, Mascarenes and Seychelles. Proc.zool.Soc.Lond., 369-382. LUZ

BOULLE, V.

1902 See SEYCHELLES: GOVERNMENT.

BOULTON, F.R.P.

1960 Bird notes of a visit to islands in the Seychelles and adjacent groups north of Madagascar. Sea Swallow, 13: 48-50. [Notes on visits to Aldabra, Desroches, Farquhar and Mahé.] N

BOURGOGNE, J.

1963 Sur deux Psychidae exotiques . . . . Bull.Soc.ent.Fr., 68: 260-263. [Two specimens collected in Aldabra and Cosmoledo by H.Legrand in 1959.] N §

BOURNE, G.C.

1886a On the island of Diego Garcia of the Chagos group. Proc. R.geogr.Soc.Lond., 8: 385-393. LUC

1886b General observations on the fauna of Diego Garcia, Chagos group. Proc.zool.Soc.Lond., 331-334. LUZ

1888a The atoll of Diego Garcia and the coral formations of the Indian Ocean. Nature, Lond., 37: 546-550. LUC

1888b The atoll of Diego Garcia and the coral formations of the Indian Ocean. Proc.R.Soc., 43: 400-461, 1 pl. Z

BOURNE, W.R.P.

1959 Notes on sea reports received in 1958-1959. Sea Swallow, 12: 6-17. [Included Indian Ocean reports.] Edward Grey Institute, Oxford §

1960 The petrels of the Indian Ocean. Sea Swallow, 13: 26-39. N

1962 The white-bellied petrel. In: Handbook of North American birds, edited by R.S.Palmer, 1: 251-254. New Haven and London, Yale University Press. [Thought to have been seen in the Chagos area.] ns it: BOURNE, W.R.P. 1971

1963 See MORRIS.

1965 Long-distance vagrancy in the petrels. Ibis, 109: 1967, 141-167. [Mentioned Oceanodroma leucorrhoa monorhis in the Indian Ocean.] P

1966 Observations on islands in the Indian Ocean. Sea Swallow, 18: 40-43. [Included notes on recent visits by RN ships to Agalegas, Aldabra, Assumption, Astove, Coetivy, Desnoefs, Desroches, Diego Garcia and Farquhar, as well as Menai, islands.] N

1969 See LAPTHORN.

1970a Observations of seabirds. Sea Swallow, 20, 47-55. [Included some Indian Ocean reports.] Edward Grey Institute, Oxford §

1970b The birds of Aldabra. App.1 in BEAMISH 1970, 208-219. Bebington Public Library §

1971 The birds of the Chagos group, Indian Ocean. Atoll Res. Bull., no.149, 175-207. [In STODDART, D.R. and TAYLOR, J.D. (eds.).] NL §

BOUTON, L.

1857a Plantes médicinales de Maurice. ns u
Second edition, 1864. Port Louis, Cernéen. N §

1857b Plantes médicinales de Maurice indigènes ou cultivées dans les jardins. Trans.R.Soc.Arts Sci.Maurit. 1: 1- . ns tt: WLSP

1871 See BOJER 1835.

1872 Observations sur la nature et les produits des îles Seychelles. With a reply from DARWIN, C.R. Trans.R.Soc. Arts Sci.Maurit., ser.B, 6: 167-168. [Correspondence regarding the prevalence of tall and strong persons in certain Seychelles families.] N §

BOUVIER, E.L.

1893 See MILNE-EDWARDS.

1913 Les caridines des Seychelles. Trans.Linn.Soc.Lond.(Zool.), 15: 367-472, 3 pl. [In GARDINER, J.S. and others 1907-1936.] N §

BOWDLER-SHARPE. See SHARPE, R.B.

BOWIN, C.O.

1964a Geophysical studies in the Indian Ocean by RV 'Chain' of the Woods Hole Oceanographic Institution. J.Seychelles Soc., no.4, 1965, 62-65. K §

1964b A rocky puzzle. Oceanus, 10: 24-25. [Announced a programme of geophysical observations in RV 'Chain', 1964, to obtain evidence of the origin of Seychelles.] LUO §

1964c See BUNCE.

BOWIN, C.O. and VOGT, P.R.

1965 Magnetic lineation between Carlsberg Ridge and Seychelles Bank, Indian Ocean. J.geophys.Res., 71: 1966, 2625-2630. LUO

Also in IIOE Repr. 4: 1967, 831-836.

BRADLEY, J.T.

1928 L'ankylostomiase aux Seychelles. Victoria, Government Printer. ns u §

1930 Catéchisme élémentaire d'hygiène domestique et personelle à l'usage des infirmières, des sages-femmes et des écoles. Victoria, Government Printer. ns u §

1936 The history of Seychelles. Victoria, Clarion. 2 vol. C: in catalogue but missing §

Second edition, 1940. NC (from Mauritius Institute) §

BRADSHAW, L.A.

1954 Know your own country: a primary school geography of Seychelles. Illustrated by Margaret Hincklieff. London, Macmillan. C §

BRAITHWAITE, C.J.R.

1968 Diagenesis of phosphatic carbonate rocks on Rémire, Amirantes, Indian Ocean. J.sedim.Petrol., 38: 1194-1212. [With an abstract.] LUG §

1970 Seychelles reefs: structure and development. Symp.zool. Soc.Lond., no.28, 1971, 39-63. [In STODDART, D.R. and YONGE (eds.). With a synopsis.] LUZ §

BRANDER, K.M.
1969 See FARROW.

BRANDER, K.M., McLEOD, A.A.Q.R. and HUMPHREYS, W.F.
1970 Comparison of species diversity and ecology of reef-living invertebrates on Aldabra Atoll and at Watamu, Kenya. Symp. zool.Soc.Lond., no.28, 1971, 397-431. [In STODDART, D.R. and YONGE (eds.). With a synopsis.] LUZ

BRANDIS, Sir D.
1894 An enumeration of the Dipterocarpaceae . . . . J.Linn.Soc. (Bot.), 31: 1895-1897, 1-148, 3 pl. [Vateria seychellarum on 144.] N

BRAUER, A.
1896 Die Seychellen auf Grund eigener Anschauung. Verh.Ges.Erdk. Berl., 23: 300-309, 1 pl. G

1897 See FOREL.

1898 Einer neuer Fall von Brutpflege bei Fröschen. Zool.Jb., Syst., 12: 1899, 89-94. [Arthroleptis seychellensis Böttger, one carrying nine tadpoles on its back, from Morne Seychellois, Mahé.] N

1902 Diagnosen von neuen Tiefseefischen, welche von der 'Valdivia'-Expedition gesammelt sind. Zool.Anz., 25: 277-298. [Several Indian Ocean species described.] LUZ

1906 Die Tiefsee-Fische [of the German Deep-sea Expedition]. Valdivia Rep., 15: pt.1, 1908, 1-432; pt.2, 1908, 1-266, 44 pl. Z

BRAZELL, J.H.
1956 Summary of rainfall in Seychelles for the year 1955. Bull. E.Afr.met.Dep., 1-10. [See also EAST AFRICA HIGH COMMISSION: METEOROLOGICAL DEPARTMENT 1951-1955.] ns tt nl: BUCOP §

BRENNECKE, W.
1909 Ozeanographie [of the 'Planet' expedition]. Planet Rep., 3: 1-154, 44 pl. N

BRENT, C.R.
1958 See GREAT BRITAIN: ADMIRALTY 1891.

BRITISH NATIONAL COMMITTEE FOR OCEANIC RESEARCH.
1965 International Indian Ocean Expedition: RRS 'Discovery': Cruise 3 report: oceanographic work in the western Indian Ocean, 15 February to 28 September 1964. London, Royal Society. N

BRITISH NATIONAL COMMITTEE FOR OCEANIC RESEARCH (HILL, M.N. and MATTHEWS, D.H.).
1964 International Indian Ocean Expedition: RRS 'Discovery': Cruise 2 report: geology and geophysics in n.w. Indian Ocean, 23 August to 4 December 1963. London, Royal Society. N
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Also in: Opuscula duo singularia: I. De nuce medica; II. De hemerobio sive ephemero insecto, pp.1-57, 10 pl. Amsterdam, Charpentier. [Pt.1, reprinted with the other work.] N

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1907 Second report. Rep.Br.Ass.Advant Sci., meeting 77, 1908, 351-353. [Contained a report by GARDINER, J.S. on the collections made during the first visit of the Sladen Expedition in 1905.] Z

1908 Third report. Rep.Br.Ass.Advant Sci., meeting 78, 1909, 305. [Contained a report by GARDINER, J.S. on his second visit to Seychelles in 1908.] Z

1909 Fourth report. Rep.Br.Ass.Advant Sci., meeting 79, 1910, 198-208. [Contained reports by GARDINER, J.S. on Seychelles, and FRYER on Aldabra, Assumption, Astove and Cosmoledo, all visited in the second part of the Sladen Expedition.] Z §

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1883 Cruise of the 'Alert': four years in Patagonian, Polynesian and Mascarene waters (1878-82). London, Swan Sonnenschein. Z

1884 Summary of the voyage. Alert Rep., 1-4. Z

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1969 Les dialectes créoles français de Maurice et des Seychelles: esquisse de phonologie suivie de textes. Te Reo, 12: 48-63. University of London §

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1966 The natural history of palms. London, Weidenfeld and Nicolson. [Contained much about Lodoicea and something about other Seychelles palms; described the distribution of palms in ch.10.] LUB

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1963 The living sea. London, Hamilton; New York, Harper Row. [Aldabra on 97-108.] G §

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1971 La vie et la mort des coraux. Paris, Flammarion. ns nl § Life and death in a coral sea. Translated by J.F.Bernard. London, Cassell. [Work in the 'Calypso'. Assumption, Cosmoledo and Seychelles in ch.4, Coetivy in ch.7. Illustrated with drawings by J.C.Roux, and many photographs] LUZ

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1964 See NEPROCHNOV.

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1963 See WASSERBURG.

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1865-1867 Quelques mots sur les racines du Lodoicea sechellarum Labill. Flore Serres, 16: 114. [A comment on WARD, S. 1863, with further information about the "bowl".] N §

CRONAN, D.S. and TOOMS, J.S.

1967 A microscopic and electron probe investigation of manganese nodules from the northwest Indian Ocean. Deep Sea Res., 15: 1968, 215-223, 9 pl. [With an abstract.] LUO

1968 The geochemistry of manganese nodules and associated pelagic deposits from the Pacific and Indian Oceans. Deep Sea Res., 16: 1969, 335-359. LUO

CROOK, J.H.

1960 The present status of certain rare land birds of the Seychelles Islands. Seychelles Govt Bull., 3 February, suppl., 1-5. ns u §

1961 The fodies (Ploceinae) of the Seychelles Islands. Ibis, 103a: 517-548. [With a summary.] P §

1964 The evolution of social organization and visual communication in weaver birds (Ploceinae). Behaviour, suppl.10, 1-178, 20 pl. [With a summary in French. Included observations of two species on Frigate.] LUZ §

CURRIE, R.I.

1963a The Indian Ocean standard net. Deep Sea Res., 10, 27-32. LUO

Coll.Repr.natn.Inst.Oceanogr., 11: no.429. LUO

Also in IIOE Repr., 2: 1966, 345-352.

1963b 'Discovery': Britain's sea-going research laboratory. New Scient., 17: 177-179. [RRS 'Discovery III'.] N
Coll.Repr.natn.Inst.Oceanogr., 11: no.430. LUO

1964 Biological exploration in the Indian Ocean. Explorers' J., 42: 71-75. [The International Indian Ocean Expedition.] G

1965 The voyage of RRS 'Discovery'. Fishg News int., 4: 81-86. [Concerned mainly with measurements of current.] LUM

1966 Some reflections on the International Indian Ocean Expedition. Oceanogr.mar.Biol.ann.Rev., 4: 69-78, 1 pl. [Included a summary of some results, relating mainly to ocean currents, and a map showing all previous expeditions.] LUO
Coll.Repr.natn.Inst.Oceanogr., 14: no.571. LUO

CUSHING, D.H.
1969 Upwelling and fish production. Fish.tech.Pap.F.A.O., no.84, 1-40. [Contained references to the Indian Ocean.] NL

DALECHAMPS, J.
1587 Historiae generalis plantarum. Lyons, Rouillons. 2 vol. [Derided Portuguese beliefs about the medicinal properties of the coco-de-mer nut on 2: 1762-1763.] N
Histoire générale des plantes. Translated by J.des Molins. Lyons, Borde Armand and Rigaud, 1653. [2: ch.33, 654.] ns it: FAUVEL, A.A. 1915

DALL, W.H.
1909 Report on the Brachiopoda obtained from the Indian Ocean by the 'Sealark' Expedition, 1905. Trans.Linn.Soc.Lond.(Zool.), 13: 1910, 439-441, 1 pl. [In GARDINER, J.S. and others 1907-1936.] N §

DALY, R.A.
1915 The glacial-control theory of coral reefs. Proc.Am.Acad. Arts Sci., 51: 1916, 155-251. [Suggested a world-wide chilling and lowering of ocean level due to the formation of ice caps during the pleistocene, followed by warming and partial return of water.] LUC

1934 The changing world of the ice age. New Haven, Yale University Press; London, Milford. [Chagos Bank on 256, Diego Garcia on 221, Seychelles Bank on 228.] LUC

DANA, J.D.
1872 Corals and coral islands. New York, Dodd Mead. ns it
Second English edition, 1875. London, Low, Marston, Low and Searle. Z
Third edition, 1890. New York, Dodd Mead. Z

DANCE, P.
1966 Scallops of the Seychelles. Seychelles Annual, 39-41. [A popular account.] O §

DANCE, S.F.
1964 The strombs of the Seychelles. Seychelles Annual, no.5, 34-36. T §

DARLINGTON, P.J., jr.
1957 Zoogeography: the geographical distribution of animals. New York, Wiley. [Lemuria on 590-591, 602; Seychelles on 522-524.] LUZ

DARUTY de GRANDPRE, C. See De GRANDPRE.

DARUTY de GRANDPRE, J.E., Marquis.
1895 La classification décimale et les bibliographies régionales. In: Bibliographie des îles africaines de l'Océan indien et australien. Brussels, Institut International de Bibliographie. ns it nl: in catalogue of Bibliothèque Nationale, Paris

DARWIN, C.R.
1839 Journal and remarks, 1832-1836. In: KING, P.P. and others: Narrative of the surveying voyages of HMS 'Adventure' and 'Beagle' between the years 1826 and 1836 . . . , 3:. [Formation of coral reefs discussed, and Chagos mentioned, in ch.20. Chagos and Seychelles land crab mentioned in ch.20.] N

Another edition as: Journal of researches into the geology and natural history of the various countries visited by HMS 'Beagle' under the command of Captain Fitroy RN . . . from 1832 to 1836. London, Colburn. N

Second edition, 1845. London, Murray. ns it §

Numerous later editions by several publishers, with various titles. N

1842 The structure and distribution of coral reefs. ns it

Third edition, 1889. London, Smith Elder. Z

Another edition, with an introduction by WILLIAMS, J.W., [n.d.]. London, Scott. ns u

1872 See BOUTON.

1874 See HOOKER, Sir J.D.

DAUTZENBERG, P.
1893 Contribution à la faune malacologique des îles Séchelles, récoltés de MM. Ch.Alluaud, A.Fauvel et Philibert. Bull. Soc.zool.Fr., 18: 78-84. [Collections listed by species.] LUZ

D'AVEZAC, M.A.P. and others.
1848 Isles d'Afrique. Paris, Firmin-Didot. ns it
Second edition, 1885. [Seychelles in pt.3, 80-114.] G
Also in: L'univers: histoire et description de tous les peuples, edited by V.Charlier, 4:. ns it: FAUVEL, A.A. 1915

DAVIDSON, W.E.
1910 Land tortoises in the Seychelles. Proc.zool.Soc.Lond., 1911, 622-624. [A letter dated 1 June, with notes on the herd at Government House, Mahé.] LUZ

DAVIES, D.
1964a Geophysical discoveries in the NW Indian Ocean. New Scient., 24: 510-513. [Reported results of seismic operations in RRS 'Discovery III' and HMS 'Owen' in 1963, discussed at a meeting called by the Royal Society on 12 November.] N

1964b See FRANCIS, T.J.G.

1964c See MATTHEWS, D.H.

1968 When did the Seychelles leave India? Nature, Lond., 220: 1225-1226. [Data from studies of magnetic anomaly patterns suggested the early palaeocene at latitude 30°S.] LUZ

DAVIES, D. and FRANCIS, T.J.G.
1964 The crustal structure of the Seychelles Bank. Deep Sea Res., 11: 1964, 921-927. [Seismic investigations had revealed 13 km. of granite beneath the central group of islands, indicating their continental character.] LUO §
Also in IIOE Repr., 4: 1967, 773-779.

DAVIS, W.M.
1918 Coral reefs and submarine banks. J.Geol. 26: 198-223, 289-309, 385-411. [Amirantes, Chagos and Seychelles discussed, especially on 386-388; Indian Ocean on 395-400. In general supported Darwin's theory.] NL

1928 The coral reef problem. Spec.Publs Am.geogrl Soc., no.9. LUO

DAWSON, P.G.
1965 Bristol University Seychelles Expedition: VI. Frigate, home of the magpie robin. Animals, 7: 520-522. N §

1966a A survey of the sea birds of the Seychelles Islands. Ool. Rec., 40: 1-12. Z

1966b The validity of Bubulcus ibis seychellarum. Ool.Rec., 40: 35-36. Z

1968 See GAYMER.

DAYER, L.
1962 M. de Malavois: l'histoire des concessions. J.Seychelles Soc., no.2, 6-13. K §

[1967] Les îles Seychelles: esquisse historique. Fribourg, Saint-Paul. [Religious history with useful references.] NC §

"D.C."
1801 Mémoire sur le sagoutier des Moluques et le cocotier des Maldives par le C. Labillardière. Bull.Soc.philomath. Paris, ser. 1, 2: 170-171. [A short report of De LABILLARDIERE.] N

De BARROS, J.
1552-1613 Decadas da Asia . . . . Lisbon, Regia Officina Typographica, 1778. 8 vol. Continued by Diogo de Couto, 1778-1788. 14 addl vol. [Contained a map of the Indian Ocean at the end of 2:; repeated beliefs about the origin and medicinal properties of coco-de-mer nuts in 5: 311 (dec.3, bk.3, ch.7).] LUC

De BERNEAUD, T.
1836 Lodoicée. In: Dictionnaire pittoresque d'histoire naturelle et des phenomènes de la nature, edited by F.E.Guérin, 4: 481-482. Paris, Bureau de Souscription. 9 vol. N

De BORMANS, A.
1894 Mission scientifique de M. Ch.Alluaud aux îles Séchelles: dermaptères. Annls Soc.ent.Fr., 64: 1895, 387-388. N

De CERE, J.N.
1788 Letter to MM. D'Entrecasteaux and De Narbonne. In LY-TIO-FANE (ed.). [Described a further despatch of spice plants to Seychelles.]

De FALLA, J.E.
1965 See MEAD.

De FROBERVILLE, E.
1845 Découverte et colonisation des îles Séchelles. Port Louis, Lacroix, 1846. ns u
Also in Annu.Voy.Géogr., 3: 1846, 56-78. ns tt nl: BUCOP gives title in B

1848 Iles africaines de la mer des Indes. In D'AVEZAC and others. [Chagos on 67, Seychelles on 89-110.]

De GAYE, J.A.
1904 Geography of the Seychelles Islands. Port Louis, Central Printing Establishment. [Written for the Victoria School, Seychelles.] C §

De GRANDPRE, C.D.
1886 Plantes médicinales de l'île Maurice et des pays intertropicaux comprenant un formulaire thérapeutique. Port Louis, General Steam Printing Co. [With a table showing the properties of the plants and their vernacular names in three languages.] C

1888a Contribution à la matière médicale de l'île Maurice: étude sur le bévilacqua Hydrocotyle asiatica (Lin.). Port Louis, Dupuy. ns it: De GRANDPRE 1888b

1888b Contribution à la matière médicale de l'île Maurice: étude sur l'herbe de flacq ou herbe grasse, guérit-vite, herbe divine, Siegisbeckia orientalis (Lin. D.C.). Port Louis, Dupuy. NC (from Mauritius Institute)

1889 Notes sur la thérapeutique coloniale de l'île Maurice, née de l'empirisme. Port Louis, Dupuy. ns it nl: in catalogue of Bibliothèque Nationale, Paris

De GRANDPRE, J.E. Daruty, Marquis. See DARUTY de GRANDPRE.

De GRANDPRE, L.M.J.C., Comte. See DEGRANDPRE.

De JOANNIS, J.
1893a Mission scientifique de M. Ch.Alluaud aux îles Séchelles: lépidoptères. Annls Soc.ent.Fr., 63: 1894, 425-438. [Found a closer similarity with African than with Indian lepidopteran fauna.] N

1893b Descriptions de trois macrolépidoptères nouveaux des îles Séchelles et quelques remarques sur la faune lépidoptérologique de ces îles. Bull.Soc.ent.Fr., 50-53. Z

1899 Note sur quelques lépidoptères des îles Séchelles. Bull. Soc.ent.Fr., 197-200. N

1915 Lépidoptères hétérocères des Mascareignes et des Seychelles (mission scientifique de M. P.Carié, 1910-1913). Annls Soc. ent.Fr., 84: 1-18, 1 pl. N

De JUSSIEU, A.L.
1789 Genera plantarum . . . . Paris, Académie des Sciences and Société de Médecine. [Contained the first systematic diagnosis of the coco-de-mer palm, called Lontarus, Rumph., on 39.] N
Another edition, 1791. Zürich, Ziegler. [Lontarus on

45.] LUB

De KERCHOVE, O.
1878 Les palmiers: histoire iconographique. Paris, Rothschild. ns it: LEMON

De LABILLARDIERE, J.J.H.
1801 Sur le cocotier des Maldives: extrait d'un mémoire lu à l' Académie des Sciences le 14 octobre 1801. Annls Mus.Hist. nat., Paris, 9: 1807, 140-145, 1 pl. [The first complete description of the coco-de-mer palm, with flowers and fruits, partly based on De QUINCY. Included a drawing of the tree by G.Lilet. With an annexe by DELEUZE.] N
See also the earlier shorter report by "D.C."

De LAROCHE, T.R.P.M.
1874 Rapport d'un mission aux Seychelles. Paris. ns u

De LAVAL. See PYRARD.

De LORIOL, P.
1883-1893 Catalogue raisonné des échinodermes recueillis par M. V.de Robillard à l'île Maurice. Mém.Soc.Phys.Hist.nat. Genève, 28: no.8, 1883, 3-64, 6 pl; 29: no.4, 1885, 3-84, 16 pl; 32: no.3, 1893, 3-66, 25 pl. N

De MALAVOIS, L.J.B.P.
1787a Notice ou aperçu général sur les isles Seychelles pour répondre aux questions du Citoyen Capitaine Général. In FAUVEL, A.A. 1909, 225-247. [A description of the islands with notes on the flora and fauna.]

1787b Mémoire sur la qualité du sol de l'isle Seychelles. In FAUVEL, A.A. 1909, 248-257.

1787c Etat général des terrains concédables aux isles Seychelles. In FAUVEL, A.A. 1909, 257-268.

1787d Mémoire sur les bois de l'archipel de Seychelles. In FAUVEL, A.A. 1909, 269-278.

1787e Mémoire sur la tortue de terre, la tortue de mer et le caret de Seychelles. In FAUVEL, A.A. 1909, 278-286.

De MARTIUS, C.F.P.
1837-1853 Historia naturalis palmarum. Leipzig, Weigel. 3 vol., plus separate vol. of pl. [Lodoicea in 3: 221-223 and 4 pl., based on the same material as that used by HOOKER, Sir W.J., but giving a rather more detailed description.] N

De MEILLON, B.
1953 See FREEMAN.

De ORTA. See ORTA.

De PEYERIMHOFF, P.
1914 See GROUVELLE.

De QUINCY, Q.
1801 Description de l'arbre cocotier de mer des Seychelles. Port Louis, Cernéen, 1893. [The memoir on which De LABILLARDIERE partly based his description.] ns it: FAUVEL, A.A. 1915, 212-213, 306
Reprinted, 1905. ns
Largely reprinted in FAUVEL, A.A. 1915, 235-240.
Extracted in DELEUZE, which appeared as an annexe to De LABILLARDIERE.

De SAINT VINCENT, J.B.G.M. Bory, Baron. See BORY de SAINT VINCENT.

De SAUSSURE, H.
1899 Orthoptera of Voeltzkow's first expedition . Abh.senckenb. naturforsch.Ges., 21: 567-664, 2 pl. [In VOELTZKOW and others 1897-1905.] N

De SAUSSURE, H. and ZEHNTER, L.
1902 Myriapodes de Madagascar. In GRANDIDIER and others, 37: 1-356, 15 pl. [Included several Seychelles species.]

De SELYS-LONGCHAMPS, E., Baron.
1869a Odonates des îles Seychelles. Annls Soc.ent.Belg., 12: 95-99. [Five new species collected by E.P.Wright.] N

1869b List of species and descriptions of a new genus and five new species of dragonflies (Odonata) from the Seychelles. Ann. Mag.nat.Hist., ser.4, 3: 272-277. LUC
Also in WRIGHT, E.P. 1870a.

De SORNAY, P.
1922 Le guano phosphaté. Revue agric.Ile Maurice, 292-296. E

De TCHIHATCHEFF, P.
1878 Considérations géologiques sur les îles océaniques. In: Végétation du globe, edited by A.Grisebach, 2:. Paris, Baillière. [Seychelles in 2: 22-23.] N §

De TOULGOET, H.
1965 Descriptions d'Arctiidae nouveaux de Madagascar (Lep.). Bull.Soc.ent.Fr., 70: 217-230. [Included Spatulosia legrandi collected by H.Legrand in Aldabra.] N §

De la VARDE, R.P.
1957 Contribution à la flore bryologique des Seychelles. Svensk bot.Tidskr., 51: 160-162. [Eleven species of mosses, including two new, collected by Sörlin in Mahé in 1955.] LUB §

De WITTE, G.F. and LAURENT, R.
1943 Contribution à la systématique des formes dégradées de la famille des Scincidae, apparentées au genre Scelotes Fitzinger. Mém.Mus.r.Hist.nat.Belg., ser.2, 26: 1-44. [Dealt mainly with African but mentioned Seychelles forms.] LUC

DEACON, G.E.R.
1935 See CLOWES.

1960 The Indian Ocean Expedition. Nature, Lond., 187: 561-562. Z
Coll.Repr.natn.Inst.Oceanogr., 8: no.320. Z

1964 With 'Discovery' in the Indian Ocean. Oceanus, 10: 16-19. [RRS 'Discovery III' in 1963.] LUO

1966 Hans Pettersson, 1888-1966. With a bibliography by SEARS, Mary. Biogr.Mem.Fellows R.Soc., 12: 405-421. [Leader of the 'Albatross' expedition to the equatorial oceans, 1947-1948.] LUC
Coll.Repr.natn.Inst.Oceanogr., 14: no.573. LUO

DECARY, R.
1939 See FRAPPAZ 1824c.

1953 Archipel des Seychelles, ancienne terre française. Encycl. mens.Outre-mer, 3: 219-222. NC §

Von der DECKEN, C.C., Baron.
1879 See ROSCHER.

DEGRANDPRE, L.M.J.C., Comte.
1801 Voyage dans l'Inde et au Bengale, fait dans les années 1789 et 1790. Paris, Dentu. 2 vol. [Seychelles in 1: 2-24.] G

DELACOUR, J.
1929 The red-crowned wart pigeon. Avicult.Mag., ser.4, 7: 105-107, 1 pl. [An account of a successful rearing of Alectroenas pulcherrima at Villers-Britonneux in 1914-1918.] N §

1944 A revision of the family Nectariniidae (sunbirds). Zoologica, N.Y., 29: 17-38. [N.dussumieri from Seychelles on 28.] LUZ

DELEUZE, J.P.F.
1807 Extrait d'un mémoire envoyé au Muséum par M. Quéau-Quincy, Commandant et Administrateur général des îles Séchelles, sur le palmier qui produit les fruits appelés cocos des Maldives. Annls Mus.Hist.nat., Paris, 9: 146-148. [Lodoicea. See De QUINCY. Annexed to De LABILLARDIERE.] N

DENDY, A.

1913 Report on the calcareous sponges collected by HMS 'Sealark' in the Indian Ocean. Trans.Linn.Soc.Lond.(Zool.), 16: 1-29, 5 pl. [In GARDINER, J.S. and others 1907-1936.] N §

1915a Report on the hexactinellid sponges (Triaxonida) collected by HMS 'Sealark' in the Indian Ocean. Trans.Linn.Soc. Lond.(Zool.), 17: 1916, 211-224, 4 pl. [In GARDINER, J.S. and others 1907-1936.] N §

1915b Report on the Homosclerophora and Astrotetraxonida collected by HMS 'Sealark' in the Indian Ocean. Trans.Linn.Soc.Lond. (Zool.), 17: 1916, 225-271, 5 pl. [In GARDINER, J.S. and others 1907-1936.] N §

1922 Report on the Sigmatotetraxonida collected by HMS 'Sealark' in the Indian Ocean. Trans.Linn.Soc.Lond.(Zool.), 18: 1-164, 18 pl. [In GARDINER, J.S. and others 1907-1936.] N §

DEQUAIRE, J.

1965 La culture et la préparation de la vanille. J.Seychelles Soc., no.5, 1966, 14-28. K §

Des AVANCHERS, L.

1857 Notice géographique et historique sur les îles Séchelles. Nouv.Annls Voy., ser.6, 1: 222-230; and Nouv.Annls marit. colon., 18: 309-314. B

DEVEREUX, W.C.

1869 A cruise in the 'Gorgon'; or, eighteen months on HMS 'Gorgon' engaged in the suppression of the slave trade on the east coast of Africa; including a trip up the Zambesi with Dr. Livingstone. London, Bell and Daldy. [Seychelles in chs. 9 and 23.] G

DEYROLLE, E.

1876 [Insectes observés aux Seychelles par MM. Filhol et De l'Isle.] Petites Nouv.ent., 2: 50-51. [Material from the Passage of Venus Expedition.] N

DIAKONOFF, A.

1961 Records and descriptions of exotic Tortricoidea (Lep.). Annls Soc.ent.Fr., 130: 49-76, 1 pl. [Several Seychelles species described.] N §

1969 Tortricidae from the Seychelles and Aldabra (Lepidoptera). Tijdschr.Ent., 112: 81-100, 13 pl. [Collected by H. Legrand. A supplement to LEGRAND 1965.] N §

1970 A new tortricid from the Seychelles. Annls Soc.ent.Fr., new ser., 6: 995-998. [Australacleris memorabilis collected in Mahé by the author.] N §

DIAMOND, A.W.

1969a See PENNY, M.J.

1969b The ecology of the sea birds of Aldabra. Phil.Trans.R.Soc., ser.B, 260: 1971, 561-571. [In WESTOLL and STODDART, D.R. (org.).] LUC §

1970a See BAYNE.

1970b See BAYNE.

DICKIE, G.

1873 On the Algae of Mauritius. J.Linn.Soc.(Bot.), 14: 190-202. [Contained several Indian Ocean species.] LUB

DICKSON, G.O.

1967 See HEIRTZLER.

DIELS, L.

1922 Beiträge zur Kenntnis der Vegetation und Flora der Seychellen. Valdivia Rep., 2: pt.1, 407-466, 18 pl. K

DIOLE, P.

1971 See COUSTEAU.

DISTANT, W.L.

1908 'Sealark' Rhynchota. Trans.Linn.Soc.Lond.(Zool.), 13: 1909, 29-47, 1 pl. [In GARDINER, J.S. and others 1907-1936.] N §

1912a Homoptera: fam. Cicadidae: subfam. Cicadinae. Genera Insect., no.142, 1-64, 7 pl. [Yanga seychellensis described on 13.] N

1912b See SCOTT, H.

1913 Rhynchota: I. Suborder Heteroptera [of the Sladen Expedition]. Trans.Linn.Soc.Lond.(Zool.), 16: 139-191, 3 pl. [In GARDINER, J.S. and others 1907-1936.] N §

1916 Rhynchota: II. Suborder Homoptera [of the Sladen Expedition]. Trans.Linn.Soc.Lond.(Zool.), 17: 1917, 273-322, 3 pl. [In GARDINER, J.S. and others 1907-1936.] N §

DIXON, C.

1898 Lost and vanishing birds . . . . London, Macqueen. [A popular account; included the Aldabra rail.] N §

DIXON, H.N.
1929 On a small collection of mosses from the Seychelles. Annls bryol., 2: 5-9. [Collected by Rév.Père Quirin in 1921.] N

DODERLEIN, L.
1902 Die Korallengattung Fungia. Abh.senckenb.naturforsch.Ges., 27: 1905, 1-162, 25 pl. [In VOELTZKOW and others 1897-1905. Three species from Aldabra mentioned.] LUZ

1906 Die Echinoiden der Deutschen Tiefsee-Expedition. Valdivia Rep., 5: 61-290, 42 pl. [Included eleven species from Chagos, listed on 276.] LUO

1911 Die gestielten Crinoiden der Deutschen Tiefsee-Expedition. Valdivia Rep., 17: 1912, 1-34, 12 pl. Z

DOFLEIN, F.
1903 Brachyura [of the German Deep-sea Expedition]. Valdivia Rep., 6: 1904, 1-314, 58 pl. [In German.] Z

DOFLEIN, F. and BALSS, H.
1913 Die Galatheiden der Deutschen Tiefsee-Expedition. Valdivia Rep., 20: pt.1, 1913, 125-184, 6 pl. Z

DOLLFUS, A.
1893 Voyage de M. Ch.Alluaud aux îles Séchelles: crustacés isopodes terrestres. Bull.Soc.zool.Fr., 18: 186-190. [Seven species described.] LUZ

DOLUTOV, Y.S.
1968 On the evolution of atolls. Vest.Mosk.gos.univ., geogr. ser., 6:. ns it: STODDART, D.R. 1971g

D'ORTA. See ORTA.

DREW, E.A.
1969a See BARNES, J.

1969b See BELLAMY.

1970 See BARNES, J.

Du TOIT, A.L.
1937 Our wandering continents: an hypothesis of continental drifting. Edinburgh, Oliver and Boyd. [Especially 226-228.] B

DUC. See Le DUC, LEDUC.

DUFO, H.

1840 Observations sur les mollusques marins, terrestres et fluviatiles des îles Séchelles et des Amirantes. C.r.hebd. Séanc.Acad.Sci., Paris, 10: 392-397. [Reported by A.de Blainville.] N

Extracted in Annls Sci.nat.Zool., ser.2, 14: 45-80, 166-221. N § [45-80]

DUING, W.

1965 Mit 'Meteor' im indischen Ozean. Umschau, 65: 304-308. S

DUMONT-D'URVILLE, J.S.C.

1834 Voyage pittoresque autour du monde: résumé générale des voyages de découvertes de Magellan, Tasman . . . . Illustrated by De Sainson. Paris, Tenré. 2 vol. [Seychelles in 1: 83-85.] B

Revised edition, 1863, as: Voyage autour du monde . . . . Paris, Furne. 2 vol. [Seychelles in 1: 101-103.] B

D'UNIENVILLE, A.M., Baron

1818 Statistique de l'île Maurice et de ses dépendances. Port Louis, Merchants' and Planters' Gazette Press, 1886. 3 vol. [Seychelles in 3: 131.] ns it: FAUVEL, A.A. 1915

1829 Statistique de l'île Maurice. Paris, Barba. 3 vol. [Especially 3: 152-154, 196.] ns it nl: in catalogue of Bibliothèque Nationale, Paris §

1838 Statistique de l'île Maurice et ses dépendances . . . . Paris, Barba. 4 pt. [Especially pt.3, 182-217, where geographical facts were given for all the islands in the region.] C

DUNNAT, F.

1850 Notes statistiques sur îles Seychelles. Port Louis, [the author]. ns u §

DUPON, J.F.

1971 L'agriculture des Seychelles. Revue Géogr.Univ.Bordeaux. ns u

DUPONT, I.

1881 Report of Acting Magistrate for the Smaller Dependencies of Peros Banhos and Diego Garcia. Port Louis. ns it: STODDART, D.R. 1971g

1883 Report of the Acting Magistrate for the Lesser Dependencies on the islands of the Chagos group for the year 1882. Port Louis. ns it: STODDART, D.R. 1971g

1884a Report on Peros Banhos and Diego Garcia. Port Louis. ns it: STODDART, D.R. 1971g

1884b Special report on the island of Diego Garcia. Port Louis. ns it: STODDART, D.R. 1971g

1885 Report of the Magistrate for the Lesser Dependencies on his visit to the Chagos Archipelago. Port Louis. ns it: STODDART, D.R. 1971g

DUPONT, P.R.

1903 Seychelles: report on Pará rubber. Colon.Rep.misc.Ser., no.22. C

1906 Letter to HE W.E.Davidson, Governor of Seychelles. In FAUVEL, A.A. 1915, 266-267. [About Lodoicea.]

1907 Report on a visit of investigation to St.Pierre, Astove, Cosmoledo, Assumption and the Aldabra group of the Seychelles Islands. Victoria, Government Printer. [Contained lists of plants and birds, and a discussion of economic resources.] C §

1911 Guano deposits of Assumption Island, Seychelles. Bull.imp. Inst.Lond., 9: 39-44. [Summary of a report.] LUC §

1912 Report on a visit of investigation to a few parts of India and Ceylon. Victoria, Government Printer. C §

1913a Contribution a l'étude du cocotier aux Seychelles: culture, soins d'entretien et fumure. Agriculture prat. Pays chauds, 345-355. K §
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1913b Varieties of plantains and bananas cultivated in Seychelles. Kew Bull., 229-231. [Described fifteen varieties.] N §

1914 La petite fourmi noire Technomyrmex albipes (Smith). Victoria, Government Printer. ns u §

1915 The steps taken in Seychelles to combat the pest of black ants. [A report to the Governor of Seychelles.] E §

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1924c Les maladies du cocotier aux Seychelles. Bull.Dép.Agric. Pêche Seychelles, no.3, 12-13; no.4, 5-6. C §

1924d De l'utilité des engrais aux Seychelles. Bull.Dép.Agric. Pêche Seychelles, no.4, 2-3. C §

1924e La distillation des feuilles de cannelle aux Séchelles. Bull.Dép.Agric.Pêche Seychelles, no.4, 4-5. C §

1925a La culture du cocotier dans les îles madréporiques du groupe des Seychelles. Bull.Dép.Agric.Pêche Seychelles, no.5, 1-3. C §

Coconut culture in the madreporic islands of the Seychelles Archipelago. Bull.Dép.Agric.Pêche Seychelles, no.6, 1926, 1-3. N §

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1925c Seychelles guano deposits. Fert.Feed.Stuffs J., 10: 214. [Suggested a recent rather than a pleistocene formation.] A

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1926b L'huile essentielle de palmarosa. Bull.Dép.Agric.Pêche Seychelles, no.6, 6; no.7, 8. E §

1926c Du développement eventuel des pêcheries aux Seychelles. Bull.Dép.Agric.Pêche Seychelles, no.6, 7-8. E §

1926d L'huile essentielle de vétivert. Bull.Dép.Agric.Pêche Seychelles, no.6, 9. E §

1926e Le kapok. Bull.Dép.Agric.Pêche Seychelles, no.6, 11-12. E §

1926f The culture of coconuts in Seychelles and various aspects of agricultural methods adopted in that Colony. Bull.Dép. Agric.Pêche Seychelles, no.7, 2-3. E §

1926g A propos de l'utilisation des engrais chimiques dans la culture du cocotier aux Seychelles. Bull.Dép.Agric.Pêche Seychelles, no.7, 3-5. E §

1926h Des méthodes de terrassement en pays montagneux. Bull. Dép.Agric.Pêche Seychelles, no.7, 5-6. E §

1926i La culture des plantes intercalaires dans les cocoteries aux Seychelles. Bull.Dép.Agric.Pêche Seychelles, no.7, 6-7. E §

1926j L'huile essentielle de gingembre. Bull.Dép.Agric.Pêche Seychelles, no.7, 9-10. E §

1926k L'huile de chalmoogra. Bull.Dép.Agric.Pêche Seychelles, no.7, 10-11. E §

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1927b Le patchouli aux Seychelles. Bull.Dép.Agric.Pêche Seychelles, no.8, 2-3. E §

1927c De la fumure des plantes vivaces comme le cocotier. Bull. Dép.Agric.Pêche Seychelles, no.8, 4. E §

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1927f Des ravages causés par les cochenilles sur les cocotiers aux Seychelles. Bull.Dép.Agric.Pêche Seychelles, no.8, 7-8. [Pinnaspis and Ischnaspis.] E §

1927g De la maladie du cocotier causée par le "petit moutouc" et des moyens de la combattre. Bull.Dép.Agric.Pêche Seychelles, no.8, 8-9. [Melittomma insulare.] E §

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1934c Les Seychelles formaient-elles autrefois partie d'un continent? Bull.Dép.Agric.Pêche Seychelles, no.12, 5-6. C §

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1934f L'archipel des Seychelles, sa formation géologique, ses ressources naturelles, sa flore, sa faune entomologique, et son évolution économique. Trans.R.Soc.Arts Sci.Maurit., ser.C, no.3, 1935, 50-149. [A review by the Director of Agriculture, Seychelles. Contained a list of species with local names.] N §

Republished separately as: L'archipel des Seychelles: ses ressources naturelles, sa faune entomologique et son évolution économique. Port Louis, Gaud, 1938. N §

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1935c Les récifs de corail. Revue agric.Ile Maurice, 1936, 48-50. [Discussion of the implications of the Sladen Expedition findings.] E

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1937a L'invasion de plus en plus menaçante d'une fourmi nuisible. Revue agric.Ile Maurice, 184-185. [Technomyrmex albipes.] E §

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1915 Le cocotier de mer des îles Seychelles (Lodoicea sechellarum). Annls Mus.colon.Marseille, ser.3, 3: 169-307, 16 pl. [With a bibliography, in chronological order, of 122 items dating from 1519 to 1836, of which some locations were given. Some bibliographical data differ from our findings, and there were inconsistencies between bibliography and text.] N §

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1915 Notice sur A.A.FAUVEL. Annls Mus.colon.Marseille, ser.3, 3: 165-167. [Concerning the French naturalist and historian, 1854-1909, with a list of his chief publications.] N §

1920 Annélides polychètes de Madagascar, du Muséum R.d'Histoire Naturelle recueillis par M.le Dr.W.Kaudern en 1912. Ark. Zool., 13: no.24, 1921, 1-32, 1 pl. [Several Indian Ocean species described.] LUZ

FAYON, M.

1968 A bird count on Cousin Island. J.Seychelles Soc., no.6, 43-44. [Of the Seychelles brush warbler.] K §

1971 The plight of the paradise flycatcher. J.Seychelles Soc., no.7, 8-11. [Recorded the occurrence of only some fifty Tchitrea corvina on La Digue Island, Seychelles.] K §

FELL, J.W.

1967 Distribution of yeasts in the Indian Ocean. Bull.mar.Sci. Gulf Caribb., 17: 454-470. [Data from a north-south transect at longitude 60°E. taken in RV 'Anton Bruun'. Dealt also with some moulds. With an abstract in English and a summary in Spanish.] LUO

Contribution no.783 of the University of Miami Institute of Marine Science. ns it

Also in IIOE Repr., 6: 1969, 312-328.

FERRIERE, C.

1912 See BOLIVAR.

FIDDICK, P.
1968 This is Aldabra: colour it pink because it belongs to you. Nova, Lond., January, 36-38. ns tt

FINDLAY, A.G.
1866 A directory for the navigation of the Indian Ocean, with descriptions of its coasts, islands, etc., from the Cape of Good Hope to the Strait of Sunda and Western Australia, including also the Red Sea and the Persian Gulf; the winds, monsoons and currents, and the passages from Europe to its various parts. ns it

Third edition, 1876. London, Laurie. [Pt.1 described winds, tides, currents, passages. Pt.2, ch.9, contained descriptions of Agalegas, Aldabra, Alphonse, Amirantes, Assumption, Astove, Chagos, Coetivy, Cosmoledo, Farquhar, Fortune Bank, George Island, Providence, Saya de Malha Bank, Seychelles.] N

Fourth edition, 1882. ns it: STODDART, D.R. and POORE 1970b

FINSCH, O.
1887 Ein Besuch auf Diego Garcia im indischen Ozean. Dte geogr.Bl., 10: 30-42. [Reported mainly on birds seen in a brief visit.] G

FINSCH, O. and BLASIUS, R.
1887 Diego Garcia und seine Seeschwalben. Ornis, 361-393. Z

FISCHER, P.
1871 Révision des espèces du genre Vaginula, Férussac. Nouv. Archs Mus.Hist.nat., Paris, 7: 147-175, 1 pl. [V.seychellensis on 155 and pl.] LUC

1891 Catalogue et distribution géographique des mollusques terrestres, fluviatiles et marins d'une partie de l'Indo-Chine. Bull.Soc.Hist.nat.Autun, 4: 1-192. [Distribution studies included Chagos species.] N

FISCHER, W.
1916a Gephyreen der Deutschen Tiefsee-Expedition. Valdivia Rep., 22: 1922, 1-26, 2 pl. Z

1916b Die Gephyreenausbeute der Deutschen Tiefsee-Expedition (1898-1899). Zool.Anz., 48: 1917, 14-20. LUZ

FISHER, J.M.M.
1970 See PHILIP.

FISHER, J.M.M., SIMON, N., VINCENT, J. and others.
1969 The red book: wild life in danger. London, Collins. [Contained Chelonia mydas, Copsychus sechellarum, Dugong dugon, Falco araea, Foudia seychellarum, Nesillas sechellensis, Otus insularis, Sula abbotti and Terpsiphone

corvina.] N §
La vie sauvage en sursis. Translated by M.Cuisin. Paris and Neuchâtel, Delachaux and Niestlé, 1970. ns

FISHER, R.L.
1965 See ENGEL, Celeste G.

FISHER, R.L., ENGEL, Celeste G. and HILDE, T.W.C.
1967 Basalts dredged from the Amirante Ridge, western Indian Ocean. Deep Sea Res., 15: 1968, 521-534, 2 pl. [Work in RV 'Argo', 1964; with a bathymetric map, map of magnetic anomaly data and abstract; found evidence for a southward movement of Madagascar.] LUO §
Also in IIOE Repr., 7: 1971, 1207-1220.

FISHER, R.L., JOHNSON, G.L. and HEEZEN, B.C.
1967 Mascarene plateau, western Indian Ocean. Bull.geol.Soc.Am., 78: 1247-1266, 6 pl. LUG
Also in IIOE Repr., 6: 1969, 1323-1356.

FLETCHER, T.B.
1909 Lepidoptera, exclusive of the Tortricidae and Tineidae, with some remarks on the distribution and means of dispersal amongst the islands of the Indian Ocean. Trans.Linn.Soc. Lond.(Zool.), 13: 1910, 265-324, 1 pl. [In GARDINER, J.S. and others 1907-1936.] N §

1910 The Orneodidae and Pterophoridae of the Seychelles expedition. Trans.Linn.Soc.Lond.(Zool.), 13: 397-404. [In GARDINER, J.S. and others 1907-1936.] N §

FLEUTIAUX, E.
1893 [Sur la Lémurie.] Bull.Soc.ent.Fr., 329. [Letter read at sess. 13 December.] Z

1903 Elaterides des îles Séchelles recueillis par M. Ch.Alluaud en 1892. Bull.Soc.ent.Fr., 13-14. N §

1922 Coleoptera: Melasidae et Elateridae des Séchelles et des îles voisines. With notes by SCOTT, H. Trans.R.ent.Soc.Lond., 1923, 398-436, 1 pl. [Fifteen species from the Sladen Expedition.] LUZ

FLOCH. See Le FLOCH.

FOCK-HENG, P.A.
1965 Cinnamon of the Seychelles. Econ.Bot., 19: 257-261. LUB §

FOMICEV, A.V.
1964 Study of the currents in the northern part of the Indian Ocean. Trudȳ Inst.Okeanol., 64: 43-50. [In Russian.

Results of RV 'Vityaz'.] NL
Also in IIOE Repr., 1: 1965, 371-378. [With an untitled summary in English; English title on xiv.]

FOOD AND AGRICULTURAL ORGANIZATION. See UNITED NATIONS ORGANIZATION: FOOD AND AGRICULTURAL ORGANIZATION.

FOREL, A.
1897 Ameisen aus Nossi-Be, Majunga, Juan de Nova (Madagaskar), der Aldabra-Inseln und Sansibar. With an appendix on ants of the Seychelles by BRAUER, A. Abh.senckenb.naturforsch.Ges., 21: 183-208. [In VOELTZKOW and others 1897-1905. Juan de Nova is Farquhar.] N

1907 Fourmis des Seychelles, Amirantes, Farquhar et Chagos. Trans.Linn.Soc.Lond.(Zool.), 12: 91-94. [In GARDINER, J.S. and others 1907-1936.] N §

1912 Fourmis des Seychelles et des Aldabras, reçues de M. Hugh Scott. Trans.Linn.Soc.Lond.(Zool.), 15: 159-167. [In GARDINER, J.S. and others 1907-1936.] N §

FORSTER, G.R., BADCOCK, J.R., LONGBOTTOM, M.R., MERRETT, N.R. and THOMSON, K.S.
1970 Results of the Royal Society Indian Ocean deep slope fishing expedition, 1969. Proc.R.Soc., ser.B, 175: 367-404, 2 pl. [With an abstract. Visited Aldabra, Farquhar and Providence groups in FRV 'Manihine'; caught 638 specimens on drop lines at night at depths of between 100 and 1000 m. Latimeria not found.] LUC

FOSBERG, F.R.
1955 See SACHET.

1967 Unique Aldabra. Atlant.Nat., 22: 160-165. [A plea for conservation, not military use.] NL

1969a See STODDART, D.R.

1969b Preliminary survey of Aldabra vegetation. Phil.Trans.R.Soc., ser.B, 260: 215-225. [In WESTOLL and STODDART, D.R. (org.). With an abstract.] LUC §

1969c Geomorphic cycle on Aldabra: hypothesis. Proc.Symp.Corals coral Reefs, mar.biol.Ass.India, Mandapam Camp. ns it: STODDART, D.R., TAYLOR, J.D., FOSBERG and FARROW

1971 See SACHET.

FOSBERG, F.R. and BULLOCK, A.A.
1971 List of Diego Garcia vascular land plants. Atoll Res.Bull., no.149, 143-160. [In STODDART, D.R. and TAYLOR, J.D. (eds.).] NL §

FOSBERG, F.R. and RENVOIZE, S.A.

1970a Plants of Farquhar Atoll. Atoll Res.Bull., no.136, 27-33. [In STODDART, D.R. (ed.) 1970. A list of species found.] NL §

1970b Plants of Cosmoledo Atoll. Atoll Res.Bull., no.136, 57-65. [In STODDART, D.R. (ed.) 1970. A list of species found.] NL §

1970c Plants of Astove Island. Atoll Res.Bull., no.136, 101-111. [In STODDART, D.R. (ed.) 1970. A list of species found.] NL §

1970d Plants of Assumption Island. Atoll Res.Bull., no.136, 147-153. [In STODDART, D.R. (ed.) 1970. A list of species found.] NL §

1970e Plants of Desroches Island, [Amirantes]. Atoll Res.Bull., no.136, 167-170. [In STODDART, D.R. (ed.) 1970. A list of species found.] NL §

1970f Plants of Remire (Eagle) Island, Amirantes. Atoll Res. Bull., no.136, 183-186. [In STODDART, D.R. (ed.) 1970. A list of species found.] NL §

1970g Plants of African Banks (Iles africaines), [Amirantes]. Atoll Res.Bull., no.136, 193-194. [In STODDART, D.R. (ed.) 1970. A list of species found.] NL §

FOSLIE, M.

1907 The Lithothamnia of the Percy Sladen Trust Expedition in HMS 'Sealark'. Trans.Linn.Soc.Lond.(Bot.), 7: 93-108, 2 pl. N
Reprinted in Trans.Linn.Soc.Lond.(Zool.), 12: 177-192, 2 pl. [In GARDINER, J.S. and others 1907-1936.] N §

FOSTER, H.W. and BACON, E.V.

1943 Wealth for welfare. London, Macmillan. [Economic difficulties in Seychelles discussed on 96-99; research into fisheries recommended.] C

FOXON, G.E.H.

1939 Stomatopod larvae [of the John Murray Expedition]. Mabahiss Rep., 6: 251-266. N

FRAGA, F.

1966 Distribution of particulate and dissolved nitrogen in the western Indian Ocean. Deep Sea Res., 13: 413-425. LUO
Also in IIOE Repr., 4: 1967, 519-531.

1968 Distribución del nitrógeno orgánico en el Océano Indico occidental: II. Investigación pesq., 33: 1969, 163-177. [With a summary in English.] LUM §
Also in IIOE Repr., 7: 1971, 1223-1237.

FRANCE: MINISTERE DE LA MARINE ET DES COLONIES.
1874 Renseignements nautiques sur quelques îles éparses de l'Océan indien sud. Paris, Ministère de la Marine et des Colonies. ns u

FRANCIS, K.A.
1940 See IYER.

FRANCIS, T.J.G.
1964 See DAVIES.

FRANCIS, T.J.G., DAVIES, D. and HILL, M.N.
1964 Crustal structure between Kenya and the Seychelles. Phil. Trans.R.Soc., ser.A, 259: 1966, 240-261. [In HILL, M.N. and others. Seismic refraction experiments showed a shallowing of the Mohorovičic discontinuity west of the Seychelles Bank.] LUC §

FRANCIS, T.J.G. and SHOR, G.G., jr.
1965 Seismic refraction measurements in the northwest Indian Ocean. J.geophys.Res., 71: 1966, 427-449. [Suggested a connection between the linear Maldive ridge and the Deccan traps of India.] LUO
Also in IIOE Repr., 4: 1967, 781-803.

FRANKCOM, C.E.N.
1961. International Indian Ocean Expedition. Mar.Obsr, 31: 85-87. S

FRANKEL, J.J. and KENT, L.E.
1964 On rocks from the Seychelles Islands. Int.geol.Congr., sess.22, sect.10. ns tt nl: WLSP
Abstracted in ROY (ed.), Volume of abstracts, 149. [Petrography and chemical analysis of granitic rocks.]

FRAPPA, C.
1937 Contribution à l'étude des Oryctes de Madagascar. Bull. écon.Madag., new ser., no.12, 344-378. [Mentioned Scolia hyalinata, reported by P.R.Dupont to occur in Aldabra, for use against Oryctes.] E

1948 Un parasite du cocotier dans la région nord-ouest de Madagascar. Agron.trop., 3: 274-281. [Melittomma insulare.] E §

FRAPPAZ, T.
1820 Extrait de la relation d'un voyage fait à Madagascar, à Anjouan et aux Seychelles, pendant les années 1818 et 1819. Annls marit.colon., pt.2, no.33, 229-273. B

1824a Souvenirs d'un jeune marin, ou récit de plusieurs voyages faits de 1816 à 1822, à la côte de Coromandel et au Bengale, aux îles de France et de Bourbon, aux Seychelles, à Madagascar, etc., etc. J.Voy.Déc.Navig.mod., 21: no.63, January, 5-74; no.64, February, 129-207; no.65, March, 257-336; 22: no.66, April, 5-92; no.67, May, 136-190. [Seychelles in 21: 265-295.] B

1824b Souvenirs d'un jeune marin. Bull.Acad.malgache, ser.1, 3: no.4, 1904, 294-297. [A reference to FRAPPAZ 1824a.] N

1824c Voyages à la côte de Coromandel, au Bengale, aux îles de France et Bourbon, à Madagascar, au Cap de Bonne Espérance, aux îles du Cap Vert et aux Canaries. Annotated by DECARY, R. Tananarive, Decary, for Académie Malgache, 1939. In: Collections de documents concernant Madagascar et les pays voisins, 1:. [Seychelles in ch.5.] N

FRASER-BRUNNER, A.

1933 A revision of the chaetodont fishes of the subfamily Pomacanthinae. Proc.zool.Soc.Lond., 543-599, 1 pl. [Some Seychelles species included.] LUZ

1940 Notes on the plectognath fishes: III. On Monacanthus setifer Bennett and related species, with a key to the genus Stephanolepis and descriptions of four new species. Ann. Mag.nat.Hist., ser.11, 5: 518-535. [Included S.freycineti.] LUZ

1950 The fishes of the family Scombridae. Ann.Mag.nat.Hist., ser.12, 3: 131-163. [Scomber japonicus mentioned as from Seychelles.] LUZ

FRAZIER, J.

1969 Observations on sea turtles at Aldabra Atoll. Phil.Trans.R. Soc., ser.B, 260: 1971, 373-410, 4 pl. [With an abstract. In WESTOLL and STODDART, D.R. (org.).] LUC §

1970a See BAYNE.

1970b See BAYNE.

FREEMAN, P. and De MEILLON, B.

1953 Simulidae of the Ethiopian region. London, Trustees of the British Museum. [Included Simulium speculiventre from Seychelles.] LUZ

FRENETTE, J.A.

1963 Observations sur la faune des Seychelles. Washington DC. Mimeographed. ns u §

FRERE, H.B.
1874 See HOOKER, Sir J.D.

FRESSANGES, G.A.A.
1890 Antoine Bénézet: l'industrie des pailles de Lodoicea aux Seychelles. Revue hist.litt.Ile Maurice, 3: no.31, 338-340. [Contained information on hat-making material from Lodoicea.] ns tt nl: BUCOP §
Largely reprinted in FAUVEL, A.A. 1915, 217-220.

FRIEDEL, E.
1896 Reisenschildkröten von Aldabra. Zool.Gart., Frankf., 37: 30-31. [A note describing the capture and management of giant tortoises by A.Voeltzkow.] N

FRIESE, H.
1900 Hymenoptera von Madagaskar: Apidae, Fossores und Chrysididae [of Voeltzkow's first expedition]. Abh.senckenb.naturforsch. Ges., 26: 257-268. [In VOELTZKOW and others 1897-1905. Several Aldabra specimens listed.] LUZ

FROBERVILLE. See De FROBERVILLE.

FRYER, Sir J.C.F.
1908 See GARDINER, J.S.

1909a Aldabra and neighbouring islands. Proc.Camb.phil.Soc., 15: 340-346, 1 pl. N

1909b See COMMITTEE ON INVESTIGATIONS IN THE INDIAN OCEAN.

1909c See GARDINER, J.S., SOMERVILLE and FRYER.

1909d See GARDINER, J.S. and FRYER.

1910a The south-west Indian Ocean (being an account of Aldabra and certain neighbouring islands which were not explored by Prof.J.Stanley Gardiner in HMS 'Sealark'). Geogrl J., 36: 249-271. [With discussion.] Z

1910b The structure and formation of Aldabra and neighbouring islands -- with notes on their flora and fauna. Trans. Linn.Soc.Lond.(Zool.), 14: 1911, 397-442, 8 pl. [In GARDINER, J.S. and others 1907-1936. Included a map.] N §

1911 The Lepidoptera of Seychelles and Aldabra, exclusive of the Orneodidae and Pterophoridae, and of the Tortricina and Tineina. Trans.Linn.Soc.Lond.(Zool.), 15: 1912, 1-28, 1 pl. [In GARDINER, J.S. and others 1907-1936.] N §

FUNNELL, B.M. and RIEDEL, W.R. (eds.).
1967 The micropalaeontology of oceans; proceedings of the symposium held in Cambridge from 10 to 17 September 1967 under the title 'Micropalaeontology of marine bottom sediments'. Cambridge, Cambridge University Press, 1971. [Contained much Indian Ocean material.] LUG

GADOW, H.F.
1892 On the remains of some gigantic land-tortoises, and of an extinct lizard, recently discovered in Mauritius. Trans. zool.Soc.Lond., 13: 1895, 313-324, 3 pl. [Included Aldabra forms.] LUZ

1913 The wanderings of animals. Cambridge, Cambridge University Press; New York, Putnam. [Lemuria on 87.] N §

GADOW, H.F. and GARDINER, J.S.
1907 Aves, with some notes on the distribution of the land-birds of the Seychelles. Trans.Linn.Soc.Lond.(Zool.), 12: 103-110. [In GARDINER, J.S. and others 1907-1936.] N §

GAHAN, C.J.
1908 On the larvae of Trictenotoma childreni, Gray, Melittomma insulare, Fairmaire, and Dascillus cervinus, Linn. Trans.R. ent.Soc.Lond., 275-282, 1 pl. [Melittomma on 278-280 and pl.] LUZ

GALBRAITH, S.J.
1898 Vanilla culture as practiced in the Seychelles Islands. With an introduction by FAIRCHILD, D.G. Bull.Div.Bot.U.S. Dep.Agric., no.21, 1-24, 1 pl. R §

GALLAGHER, J.F.
1966 The variability of water masses in the Indian Ocean. Washington DC, National Oceanographic Data Center, Publ.G.11. [Thesis for M.Sc.] LUO

GARCIA de ORTA. See ORTA.

GARDINER, J.S.
1901 See WILLIS, J.C.

1901-1903 The Maldive and Laccadive groups, with notes on other coral formations in the Indian Ocean. In GARDINER, J.S. and others 1901-1906, 1: pt.1, 1901, 12-19; pt.2, 1902, 146-183; pt.3, 1902, 313-346, 2 pl.; pt.4, 1903, 376-423. [Included all the groups in the area. With a map.]

1902 The formation of the Maldives. Geogrl J., 19: 277-301. [With discussion.] Z

1903 The origin of coral reefs as shown by the Maldives. Am.J. Sci., ser.4, 16: 203-213. [Mentioned Chagos and Seychelles.] LUG

1904 Notes and observations on the distribution of the larvae of marine animals. Ann.Mag.nat.Hist., ser.7, 14: 403-410. Z

1905a The Percy Sladen Expedition in HMS 'Sealark': the Chagos Archipelago. Nature, Lond., 72: 571-572. [The first visit of the Sladen Expedition, 1905.] Z

1905b See SEDGWICK 1905b.

1905c See SEDGWICK 1905c.

1905d See SEDGWICK 1905d.

1906a The Indian Ocean, being results largely based on the work of the Percy Sladen Expedition in HMS 'Sealark', Comm.B.T. Somerville, 1905. Geogrl J., 28: 313-332, 454-471. [With discussion.] Z

1906b The Percy Sladen Expedition in HMS 'Sealark' to the Indian Ocean: the Seychelles Archipelago. Nature, Lond., 73: 294-296. [A letter to the editor.] Z

1906c The Percy Sladen Expedition in HMS 'Sealark': the Chagos Archipelago. Rep.Br.Ass.Advant Sci., sect.E, meeting 76, 1907, 623-624. Z

1906d See COMMITTEE ON INVESTIGATIONS IN THE INDIAN OCEAN.

1907a The Seychelles Archipelago. Geogrl J., 29: 148-174. [A general account, with discussion.] LUC

1907b See COMMITTEE ON INVESTIGATIONS IN THE INDIAN OCEAN.

1907c See GADOW.

1908a The madroporarian corals: I. The family Fungiidae, with a revision of its genera and species and an account of their geographical distribution. Trans.Linn.Soc.Lond.(Zool.), 12: 1909, 257-290, 7 pl. [In GARDINER, J.S. and others 1907-1936.] N §

1908b See COMMITTEE ON INVESTIGATIONS IN THE INDIAN OCEAN.

1909 See COMMITTEE ON INVESTIGATIONS IN THE INDIAN OCEAN.

1914a Islands in the Indian Ocean: Mauritius, Seychelles and dependencies. In: The Oxford survey of the British Empire, edited by A.J.Herbertson and O.J.R.Howarth, ch.22, 471-490. Oxford, Clarendon. G

1914b Submarine slopes. Geogrl J., 45: 1915, 202-219. [Farquhar and Salomon on 213-215; discussion.] LUC

1930a Coral reefs and atolls. London, Macmillan, 1931. [A course of lectures at the Lowell Institute, Boston, Mass.] G §

1930b Studies in coral reefs. Bull.Mus.comp.Zool.Harv., 71: 1-16. G

1931a Photosynthesis and solution in formation of coral reefs. Proc.Linn.Soc.Lond., sess.1930-1931, pt.5, 65-71. [With discussion.] G

1931b See WILLIS, J.C.

1936a The reefs of the western Indian Ocean: I. Chagos Archipelago; II. The Mascarene region. Trans.Linn.Soc.Lond.(Zool.), 19: 393-436, 1 pl. [In GARDINER, J.S. and others 1907-1936.] N §

1936b Concluding remarks on the distribution of the land and marine fauna with a list of the water temperature observations [of the Sladen Expedition]. Trans.Linn.Soc.Lond. (Zool.), 19: 447-464. [In GARDINER, J.S. and others 1907-1936.] N §

GARDINER, J.S. and COOPER, C.F.
1907 Description of the expedition. Trans.Linn.Soc.Lond.(Zool.), 12: 1-56, 10 pl.; 111-175, 5 pl. [In GARDINER, J.S. and others 1907-1936. Described the first (1905) of the two visits to the Indian Ocean which formed the Sladen Expedition, reporting mainly on the Amirantes, Chagos, Farquhar and Providence groups, Coetivy Island and Saya de Malha Bank, as well as the Cargados group. For the second visit (1908-1909), mainly to the Aldabra group and Seychelles, see GARDINER, J.S., SOMERVILLE and FRYER, or the shorter GARDINER, J.S. and FRYER 1908 and 1909.] N §

GARDINER, J.S. and FRYER, Sir J.C.F.
1908 The Percy Sladen Trust Expedition to the Indian Ocean: further explorations. Nature,Lond., 79: 204-205. [Described the second visit in HMS 'Sealark' (1908-1909), going to Aldabra, Assumption, Astove, Cosmoledo and Seychelles, including Bird and Dennis Islands. For a longer report see GARDINER, J.S., SOMERVILLE and FRYER.] Z

1909 The Percy Sladen Trust Expedition to the Indian Ocean: final explorations. Nature, Lond., 80: 321-323. [The second visit.] LUC

GARDINER, J.S., SOMERVILLE, B.T. and FRYER, Sir J.C.F.
1909 Description of the expedition (concluded), with observations for terrestrial magnetism and some account of Bird and Dennis Islands, [Seychelles]. Trans.Linn.Soc.Lond.(Zool.), 14: 1910, 1-20, 2 pl. [In GARDINER, J.S. and others 1907-1936. Described the second visit of the Sladen Expedition, in 1908-1909, reporting mainly on the Aldabra group and Seychelles. For a shorter report see GARDINER, J.S. and FRYER 1908 and 1909. For the first visit in 1905 see GARDINER, J.S. and COOPER.] N §

GARDINER, J.S. and others.
1901-1906 The fauna and geography of the Maldive and Laccadive Archipelagoes. Cambridge, Cambridge University Press. 2 vol., 2 suppl. [Contained a general discussion of coral formations in the Indian Ocean (1: pt.1-4; 2: suppl.2).] N

GARDINER, J.S. and others.
1907-1936 The Percy Sladen Trust Expedition to the Indian Ocean in 1905 under the leadership of Mr. J.Stanley Gardiner, M.A. Trans.Linn.Soc.Lond.(Zool.), 12-19:. [In HMS 'Sealark'. The series also covered the second visit of the expedition in 1908-1909.] N §

GARDINER, W.
1883 On the continuity of protoplasm through the walls of vegetable cells. Phil.Trans.R.Soc., 174: 817-863. [Perforation of cell wall in endoplasm of Lodoicea on 848 and pl.69, fig.19.] N

GASKELL, T.F.
1954 Seismic refraction work by HMS 'Challenger' in the deep oceans. Proc.R.Soc., ser.A, 222: 356-361. [Visited Seychelles.] LUC

1959 La structure séismique des grandes profondeurs océaniques. Colloques int.Cent.natn.Rech.scient., no.83, 149-156. [With discussion, and a summary in English.] G

1963 Surveying the Indian Ocean. Listener, Lond., 69: 205, 208. [Discussed the origin of Seychelles according to Wegener's theory.] P

GASKELL, T.F., HILL, M.N. and SWALLOW, J.C.
1958 Seismic measurements made by HMS 'Challenger' in the Atlantic, Pacific and Indian Oceans and in the Mediterranean Sea, 1950-53. Phil.Trans.R.Soc., ser.A, 251: 1959, 23-83. LUC

GASKELL, T.F. and SWALLOW, J.C.

1953 Seismic refraction experiments in the Indian Ocean and in the Mediterranean Sea. Nature, Lond., 172: 535-537. [Work on HMS 'Challenger', 1950-1952.] LUC

GASKILL, G.

1961 Armchair voyage to paradise. Readers' Digest, September, 25-30. ns tt nl: B, Colindale, and Bodleian Library, Oxford § [Australian edition]

"GATES, P." (HARRIS, L.W.)

1966 Octopus: without Worcester sauce. Seychelles Annual, 42-45. [A popular account.] O §

GAY, J.

1875 Bibliographie des ouvrages relatifs à l'Afrique et à l'Arabie: catalogue méthodique de tous les ouvrages en français et des principaux langues étrangères traitant de la géographie, de l'histoire, du commerce, des lettres et des arts de l'Afrique et de l'Arabie. San Remo, the author. ns it

Reprinted in Amsterdam, 1961. [Seychelles on 249.] G §

GAYE. See De GAYE.

GAYMER, R.D.T.

1965 Bristol University Seychelles Expedition: I. The islands' endangered species. Animals, 6: 544-547. [Mainly birds.] N §

1966a The land birds of the Seychelles Islands, with a note on the giant tortoise of Aldabra Atoll. Mimeographed. [A preliminary report of the Bristol University Seychelles Expedition, 1964-1965, for the World Wildlife Fund, containing summaries of information obtained for each species, and of main conservation recommendations.] ns it

1966b The green turtle Chelonia mydas japonica (Thunberg) in the Seychelles, Amirantes and Aldabra groups of islands. Mimeographed. ns it: STODDART, D.R. 1967c §

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1908 Marine Algae (Chlorophyceae and Phaeophyceae) and marine phanerogams of the 'Sealark' expedition, collected by Mr. J.Stanley Gardiner, MA, FRS, FLS. Trans.Linn.Soc.Lond. (Bot.), 7: 163-188, 3 pl. [The phanerogams were four species of Potamogetonaceae and two of Hydrocharidaceae.] N

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1908 See GEPP, A.

GERMAIN, L.

1909 Recherches sur la faune malacologique de l'Afrique équatoriale. Archs Zool.exp.gén., ser.5, 1: 1-195, 2 pl. Z

1920 Mission zoologique de M. Paul Carié aux îles Mascareignes: faune malacologique terrestre et fluviatile des îles Mascareignes. Angers, Gaultier and Thébert, 1921. [Seychelles molluscan fauna listed and discussed on 433-437.] N §

1924 La distribution géographique et l'origine des mollusques de la famille des acavides. C.r.Congr.Socs sav. Paris Sect. Sci., 254-269. [Included the endemic Seychelles genus Stylodonta; evidence for Gondwana discussed.] N

1934 L'origine et la composition de la faune malacologique terrestre et fluviatile des îles Séchelles. C.r.Congr.Socs sav.Paris Sect.Sci., no.16: 113-133. [Contained a table showing distribution of Seychelles species.] N §

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1873 Gliederthiere (Insekten, Arachniden, Myriapoden und Isopoden) [of the Decken expeditions]. Deckens Reisen, 3: pt.2. Z

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1848-1852 Zoologie et paléontologie françaises . . . . Paris, Bertrand. 3 vol. [Dioplodon densirostris in 2: and on 3: pl.40.] ns it
Second edition, 1859. 2 vol. [1: 289-290, and 2: pl. 40.] N

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1963 See COLLETTE.

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1967 Systematics and zoogeography of the stomiatoid fishes, Chauliodus pammelas and C.sloani, of the Indian Ocean. Copeia, 798-805. [Data from two north-south transects at longitude 60 and 65°E. in RV 'Anton Bruun'.] Edinburgh University §
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1938 A report on the forests of the granitic islands of the Seychelles. Victoria, Government Printer. [Listed species; stressed the serious situation arising from denudation; made recommendations.] C §

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1948 The storm-petrels occurring in the northern Indian Ocean, and adjacent seas. J.Bombay nat.Hist.Soc., 47: 443-449. LUTM

1950a Notes on Abbott's booby. Bull.Raffles Mus., 23: 65-76. [Summarized available information on Sula abbotti Ridg., formerly living on Assumption and still breeding on Christmas Island.] N

1950b The tropic-birds occurring in the Indian Ocean and adjacent seas. J.Bombay nat.Hist.Soc., 49: 67-80. [Summarized knowledge about the distribution of three species; included Assumption, Chagos and Seychelles.] N

1952 Notes on the birds reported from the Agalega Islands, western Indian Ocean. Bull.Raffles Mus., 24: 257-269. [Notes on twelve species recorded in LIONNET, J.G. 1924, identified by Bojer.] N

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1894 Mission scientifique de M. Ch.Alluaud aux îles Séchelles: diptères. Annls Soc.ent.Fr., 64: 1895, 353-368. N

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1945 Educational reorganisation in the Seychelles. Victoria, Government Printer. [A ten-year education plan for the period 1946-1955, seen as part of the general plan outlined in SEYCHELLES: DEVELOPMENT PROGRAMME COMMITTEE 1947.] C §

GILL, F.B.
1967 Observations on the pelagic distribution of seabirds in the western Indian Ocean. Proc.U.S.natn.Mus., 123: no.3605, 1-33. [Data collected in RV 'Anton Bruun' and TSS 'Kampala', 1964.] LUZ
Also in IIOE Repr., 6: 1969, 155-187.

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1779 Letter to M. Céré. In LY-TIO-FANE (ed.). [Described the plantation of clove and nutmeg trees at Anse Royale, Mahé.]

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1905 Amphioxides [of the German Deep-sea Expedition]. Valdivia Rep., 12: 1-92, 10 pl. Z

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GOODMAN, M.F.
1964 A comparative study of Creole French dialects. The Hague, London and Paris, Mouton. [Seychelles Creole regarded as close to the Mauritius form, 16.] University of Kent §

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1967 Pigeons and doves of the world. Illustrated by R.Gillmor. London, Trustees of the British Museum, Publ.no.663. [Streptopelia picturata on 140-141, Alectroenas sp. on 380-384.] N

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1966 Distribution of clay minerals in the sediments of the Indian Ocean. Okeanologia., 6: 267-275. [In Russian. Illites, chlorites, kaolinites, montmorillonites, and palygorskits were dominant.] NL
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Also in IIOE Repr., 1: 1965, 750-761. [With an untitled summary in English; English title on xvi.]

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1968b Chemical content of the suspended matter from the surface water of the northern and central part of the Indian Ocean. Okeanol.Issled., no.18, 175-192. [In Russian. From the 33rd cruise of RV 'Vityaz'.] NL
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1957 Expédition 'Moana'. Paris, Pensée Moderne. 2 vol. [Peros Banhos in 2: 224-231.] ns it §
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1909 Biologie [of the 'Planet' expedition]. Planet Rep., 4: 1-198, 9 pl. [Mainly about plankton.] N

GRAGE, M.J.F.
1967 Lestidium bigelowi, a new species of paralepidid fish with photophores. Breviora, no.277, 1-10. [With an abstract and a summary.] LUZ
Also in IIOE Repr., 6: 1969, 637-646.

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1845-1902 Histoire physique, naturelle et politique de Madagascar. Paris, Imprimerie Nationale. 39 vol. [Contained numerous references to neighbouring islands, including Aldabra group, and to Seychelles. Contained also De SAUSSURE and ZEHNTER.] N § [6: tome 1, texte 1; 10: tome 5, atlas 2; and one other vol. of plates]

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GRANDPRE, J.E. Daruty de, Marquis. See DARUTY de GRANDPRE.

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GRANT, C.H.B. and MACKWORTH-PRAED, C.W.
1933 On the relationship, status and range of Egretta garzetta, Demigretta gularis, D.schistacea, D.asha, and D.dimorpha, a new subspecies; and the correct type-locality of Egretta garzetta. Bull.Br.Orn.Club, 53: 189-196. [E.garzetta assumptionis from Assumption.] N

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1965 The adaptive significance of some size trends in island birds. Evolution, Lawrence, Ka., 19: 355-367. N

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1870-1871 On the skeleton of Dioplodon sechellensis in the Australian Museum at Sydney. Ann.Mag.nat.Hist., ser.4, 6: 1870, 343-344; 7: 1871, 291-292. LUC

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GREAT BRITAIN: AIR MINISTRY: METEOROLOGICAL OFFICE.

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[1888] Charts showing the mean barometrical pressure over the Atlantic, Indian and Pacific Oceans. Suppl., [1889]. London, HMSO. S: in catalogue but missing

1927 Preliminary report on conditions at Diego Garcia (Indian Ocean). Airship met.Rep., no.43, 1-5, 2 pl. M

1932 Notes on the meteorological observations in British Colonies and Protectorates in 1937 and summarized in the annual reports of colonial government. London, HMSO. [Included Seychelles.] ns it: WALLACE, J.A., jr.

[n.d.] Reseau mondial, 1910-1934. London, HMSO. [Tables showing the meteorology of the globe monthly and annually. Included data from Seychelles.] ns it: WALLACE, J.A., jr.

1936 Indian Ocean currents. London, HMSO. [Prepared with the authority of the Meteorological Committee.] S: in catalogue but missing

1940-1943 Weather in the Indian Ocean. M.O.451. London, HMSO. 3 vol., particularly:

1: General information. 1943, reprinted 1950. [Mainly a brief non-technical survey with charts and diagrams.] M

2: pt.8. The south Indian Ocean to lat.30°S., including the islands of . . . the Seychelles and the Chagos Archipelago. 1940. [Much data illustrated with charts and tables.] ns it: WALLACE, J.A., jr.

3: pt.1. Aids to forecasting. By PENDAL, L.E. 1942. [With a folio of coloured synoptic charts for the whole Indian Ocean.] M

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1960 Tables of temperature, relative humidity and precipitation for the world. M.O.617. London, HMSO. [Indian Ocean was in pt.4.] M

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1958 Mauritius and Seychelles. Colonial Office picture set. London, HMSO. [Photographs for use in schools; almost entirely Mauritius.] C

1964 Mauritius and Seychelles. London, HMSO. [A very short general account.] C

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1889-1890 Mauritius, (Seychelles and Rodrigues): annual reports for 1889 and 1890, with a report on the island of Aldabra. Colon.Rep., no.40. London, HMSO, 1892. [The report on Aldabra was SPURS.] C §

1891; then annual, 1894-1937 and 1946-1948; then biennial, 1949-1950 onwards Seychelles: report for the years . . . . Colon. Rep. London, HMSO. [General reports of developments in the Colony, with bibliographies.] C §

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1954 An economic survey of the colonial territories 1951. 2 vol. Colonial no.281. [Seychelles in 2: 185-193.] C §

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1968 See GREAT BRITAIN: FOREIGN AND COMMONWEALTH OFFICE.

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1951-1967 See GREAT BRITAIN: FOREIGN AND COMMONWEALTH OFFICE.

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Annual, 1969- A year book of the Commonwealth. Preceded by: Dominions Office and Colonial Office List, 1926-1940; Commonwealth Relations Office List, 1951-1966; Commonwealth Relations Office Year Book, 1967; Commonwealth Office Year Book, 1968. London, HMSO. [In 1971 edition, BIOT on 488-490, Seychelles on 546-553.] P: 1926-1940, 1951-1953, 1955-1963, 1965-

Biennial Seychelles: report for the years . . . . London, HMSO. C §

GREAT BRITAIN: SECRETARY OF STATE FOR THE COLONIES.

1951 British islands of the southern hemisphere 1945-1951. Cmd. 8230. London, HMSO. [Seychelles on 19-28.] C

GREAT BRITAIN: SECRETARY OF STATE FOR DEFENCE.

1967 Supplementary statement on defence policy 1967. Cmnd.3357. London, HMSO. [Announced continuation of the possibility of making a new staging airfield in BIOT.] LUC

GREAT BRITAIN: SECRETARY OF STATE FOR FOREIGN AFFAIRS.

1966a Exchange of notes between the government of the UKGBNI and the government of the USA concerning the availability for defence purposes of the British Indian Ocean Territory. Cmnd.3231, 1967. London, HMSO. [Announced agreement to make Aldabra, Desroches, Farquhar and the Chagos Archipelago, constituting the new BIOT, available "for the defense purposes of both Governments as they may arise".] LUA

1966b Exchange of notes between the government of the UKGBNI and the government of the USA concerning the US tracking and telemetry facilities in the island of Mahé in the Seychelles. Cmnd.3232, 1967. London, HMSO. [Announced agreement to establish facilities for orbital control and data acquisition in connection with US space projects, meteorological and seismological research and relevant communications.] LUA

GREATHEAD, D.J.

1971 A review of biological control in the Ethiopian region. Tech.Commun.Commonw.Inst.biol.Control, no.5, 1-162. [Contained short notes on coccinellids sent to Agalegas and Chagos on 60; also contained LIONNET, J.F.G. 1971e on Seychelles.] NL §

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1907 Notes on the Coccidae collected by the Percy Sladen Trust Expedition . . . supplemented by a collection received from Mr. R.Dupont, Director of Agriculture, Seychelles. Trans. Linn.Soc.Lond.(Zool.), 12: 197-207, 1 pl. [In GARDINER, J.S. and others 1907-1936.] N §

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1913 On some coccid pests from the Seychelles. J.econ.Biol., 9: 1914, 47-48. [Five species collected by P.R.Dupont.] LUTM

1916 Notes on Coccidae occurring in the Seychelles Islands, with descriptions of new species. Bull.ent.Res., 7: 193-196. [Three new species, one each from Mahé, Praslin and Silhouette, collected by P.R.Dupont.] LUTM

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1921 Coccidae from the Seychelles. Bull.ent.Res., 12: 125-128. [Seven species described.] LUTM

GREEN, L.G.
1962 Islands time forgot: memories of Africa's busy islands and Robinson Crusoe outposts . . . in the solitudes of the Atlantic and Indian Oceans. London, Putnam. B §

GREEN, M.L.
1933 See SPRAGUE.

GREENWAY, J.C.
1958 Extinct and vanishing birds of the world. New York, American Committee for International Wild Life Protection. [Three extinct and two dwindling species from Seychelles listed on 132.] N §

GREFFRATH, H.
1889 Die Seychellen oder Mahé Inseln. Allen Weltheilen, 20: 23. ns u

GREVE, S.
1938 Echo soundings: an analysis of the results [of the 'Dana' expeditions]. Dana Rep., 2: no.14, 1-25. Z

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GREY, Marion.
1955 The fishes of the genus Tetragonurus Risso. Dana Rep., 8: no.41, 1-75. Z

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1967 Bathypelagic calanoid copepods of the western Indian Ocean. Proc.U.S.natn.Mus., 122: no.3583, 1-67. [Work of RV 'Anton Bruun' in 1963 and 1964.] LUZ
Coll.Repr.Woods Hole oceanogr.Instn, no.1807. LUO
Also in IIOE Repr., 5: 1968, 491-557.

GRIFFITH, T.R. and ABBOTT, W.L.
1893 Aldabra Islands. Kew Bull., 152-155. [Letters to the Director of the Royal Botanic Gardens, Kew, reporting separate visits by these authors.] N

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1969 See LAPTHORN.

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1960 Sur quelques sphingides nouveaux ou peu connus de la région malgache. Bull.Soc.ent.Fr., 65: 40-47. [Contained a description of the unique Seychelles moth Cephonodes tamsi.] N §

1970 Sur quelques sphingides de Madagascar. Bull.Soc.ent.Fr., 75: 207-208. [Mentioned Hippotion osiris from Mahé.] N §

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1742-1744 [Extracts from unpublished reports of voyages to Indian Ocean islands.] In FAUVEL, A.A. 1900a. [With commentary by Fauvel.]

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1928 Neue Formen von Ostafrika, Aldabra und Madagaskar. Mber. Akad.Wiss.Berl., 36: 77-79. ns u

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1894 Descriptions de nouveaux clavicornes exotiques. Annls Soc. ent.Fr., 63: 12-16. [Collected by C.Alluaud and A. Grouvelle.] N

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1917 Coleoptera: Ostomidae, Monotomidae, Colydiidae and Notiophygidae from the Seychelles and Aldabra Islands. With notes by SCOTT, H. Trans.R.ent.Soc.Lond., 1918, 1-57, 2 pl. [Descriptions of thirty-four species, of which twenty-six were new, from the Sladen Expedition.] LUZ

GROUVELLE, A. and De PEYERIMHOFF, P.
1914 Coleoptera: Cucujidae, Cryptophagidae; avec une description de la larve et de la nymphe de Prostominia convexiuscula Grouvelle. Trans.Linn.Soc.Lond.(Zool.), 17: 141-159. [In GARDINER, J.S. and others 1907-1936.] N §

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1969a The growth, ecology and population structure of giant tortoises on Aldabra. Phil.Trans.R.Soc., ser.B, 260: 1971, 327-372, 2 pl. [In WESTOLL and STODDART, D.R. (org.). With an abstract.] LUC §

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1929 Nicolas Pike and his unpublished paintings of the fishes of Mauritius, western Indian Ocean, with an index to the fishes Bull.Am.Mus.nat.Hist., 58: 489-530. [Nine out of 486 specimens were from Seychelles.] LUZ

1932 The whale-shark, Rhineodon typus, among the Seychelles Islands. Nature, Lond., 130: 169. LUZ

1934 The geographical distribution of the whale-shark (Rhineodon typus). Proc.zool.Soc.Lond., 863-893, 1 pl. [Concluded that the Sulu Sea (Pacific Ocean) was the centre of dispersal.] LUZ

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1891 Sept années aux Seychelles. St.Valéry-sur-Somme, Kober. [A short account of its discovery, history, industries, natural history, crops and people.] ns u §

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1940 Faune ornithologique ancienne et actuelle des îles Mascareignes, Seychelles, Comores et des îles Amirantes. Port Louis. ns u

1952 See ROUNTREE.

GUIBOUT, P.
1957 See TCHERNIA.

GUICHENOT, M.
1865 Catalogue des scaridés de la collection du Musée de Paris. Mém.Soc.Sci.nat.Cherbourg, 11: 1-75. [Described three species attributed to Seychelles.] N

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1969 Aldabra et la protection des atolls. Norois, 16: 102-104. LUA

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1964 Crustacés décapodes brachyures (Xanthidae) des campagnes de la 'Calypso' en Mer Rouge (1952), dans le Golfe Persique et à l'île Aldabra (1954). Mém.Mus.natn.Hist.nat.,Paris, ser. A, 32: 1-108 plus iii, 12 pl. N §

GUNTHER, A.C.L.G.
1866 See PLAYFAIR.

1869 Notice of a gigantic species of Batrachus from the Seychelles Islands. Ann.Mag.nat.Hist., ser.4, 3: 131-132. [From a dried head sent to the British Museum by WARD, S. 1869.] LUC

1874 See HOOKER, Sir J.D.

1877 The gigantic land-tortoises (living and extinct) in the collection of the British Museum. London, Trustees of the British Museum. [Included the Aldabra species.] N
Reviewed by "R.E." in Nature, Lond., 18: 1878, 483-484. LUC

1879 On the occurrence of a land-rail (Rallus) in the island of Aldabra. Ann.Mag.nat.Hist., ser.5, 3: 164-168. [Called it R.gularis, var. aldebrana. Included an extract from a letter on Aldabra by WHARTON 1878 from HMS 'Fawn' off Zanzibar.] LUC

1884 Reptilia [of the voyage of the 'Alert']. Alert Rep., 486. Z

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1884 Report of the zoological collections made in the Indo-Pacific Ocean during the voyage of HMS 'Alert' 1881-2. ["Alert Rep."] London, Trustees of the British Museum. Z

GWYNNE, M.D. and WOOD, D.
1969 Plants collected on islands in the western Indian Ocean during a cruise of the MFRV 'Manihine', Sept.-Oct. 1967. Atoll Res.Bull., no.134, 1-15. NL §

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1879 On the extinct land-tortoises of Mauritius and Rodriguez. Trans.Linn.Soc.Lond.(Zool.), 2: 1881, 155-163, 1 pl. LUZ

HAECKER, V.
1906 Tiefsee-Radiolarien [of the German Deep-sea Expedition]. Valdivia Rep., 14: pt.1, 1908, 1-706; pt.2, 1908, 89 pl. Z

HAINES. See HOLDSWORTH-HAINES.

HALL, J.R.
1966 See RYTHER.

HALUNEN, A.J., jr.
1965 See BIRCH.

HAMPSON, Sir G.F., Bart.
1907 Descriptions of new genera and species of Syntomidae, Arctiidae, Agaristidae and Noctuidae. Ann.Mag.nat.Hist., ser.7, 19: 221-257. [Utetheisa pulchelloides from Amirantes, Chagos, Coetivy and Seychelles on 239-240.] LUC

1908 On the moths collected during the cruise of the 'Valhalla' during the winter 1905-6 by Mr. E.G.B.Meade-Waldo. Ann.Mag. nat.Hist., ser.8, 1: 474-492. [Species described from Aldabra, Assumption and Seychelles.] LUC

HANCHETT, Diane E.
1969 Report on the teaching of English and French in the primary and secondary schools in the Seychelles Islands, 1967. App. 10 of SEYCHELLES: DEPARTMENT OF EDUCATION annual for 1969, 29-34. ns §

HANNING-LEE. See LEE.

HARDAKER, J.B.
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1970 The green turtle in the Gulf of Aden and the Seychelles Islands. Verh.K.ned.Akad.Wet., Afd.Naturk., 58: no.5, 1-44, 7 pl. [Nesting in Aldabra group. With a summary.] N §

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872-878, 1053-1054; with maps and bibliography.] N

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1884 Hooker's Icones plantarum: . . . , ser.3, 5: pt.3. London, Williams and Norgate, 1883-1885. [Northea seychellana (Sapotaceae), pl.1473.] N

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Also Trans.R.Soc.Arts Sci.Maurit., ser.B, 9: 1876, 52-84. [With a comment by McNAB 1876.] K

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Further editions, 1811 and 1841. S
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1967 The last cruise of the 'Emden'. London, Deutsch. [The famous German raiding cruiser in the Indian Ocean, which put in for repairs at Diego Garcia in October 1914, closely followed by two British warships: 115-120.] Bury Public Library

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1940 The grasses of Mauritius and Rodriguez. Port Louis, Department of Agriculture. [Included Seychelles species.] N

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1959 Water supply of Mahé: project report. London, Crown Agents. [To the Government of Seychelles by a firm of consulting engineers.] C

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1893a Report on Agalega Islands. Port Louis. ns u

1893b Un voyage à Agaléga. Revue hist.litt.Ile Maurice, 6: 295-298, 308-314. [Contained quotations from LAPLACE and LEDUC, S.E.; otherwise in English.] NC (from Harvard College Library, Cambridge, Mass.) §

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Iohn Hvighen van Linschoten his discours of voyages into ye Easte and West Indies. Translated by W.Phillip. London, Wolfe, 1598. 4 vol. ns it: Tiele (see below)

Histoire de la navigation de Jean Hugues de Linscot Hollandais et de ses voyages aux Indes orientales . . . . Amsterdam, 1610. ns it: FAUVEL, A.A. 1915

The voyage of John Huyghen van Linschoten to the East Indies, from the old English translation of 1598. Edited by A.C.Burnell and P.A.Tiele. London, Hakluyt Society, 1885. 2 vol. [Mentioned coco-de-mer nuts in the Maldives, "good against all poyson", in 1: ch.13, 75-76, but did not name or describe them.] LUC

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1970b A short history of Seychelles. Victoria, Saint-Fidèle. [Included geography, geology, climate, flora and fauna.] N §

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1962 Geographical reconnaissance of the Arabian Sea. New Scient., 14: 513-515. [Report on geophysical and hydrological work done in HMS 'Owen' in 1961-1962, including magnetometry in Seychelles.] N

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1968 The elopoid and clupeoid fishes of East African coastal waters. Jl E.Africa nat.Hist.Soc., 27: 77-115. [Referred to records of Indian Ocean catches.] NL §

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1957 Revision of the African tortoises and turtles of the suborder Cryptodira. Bull.Mus.comp.Zool.Harv., 115: 161-557, 18 pl. [Geochelone from Aldabra and Seychelles on 221-225; Chelonia mydas on Aldabra on 474-484.] LUZ

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1967 The theory of island biogeography. Princeton NJ, Princeton University Press. [Seychelles frogs mentioned on 175.] LUA

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1967 Airstrip or birds for Darwin's island? Observer, Lond., 13 August, 5. [Reported the landing of the Royal Society Expedition in Aldabra, against a background of opposition by scientists to the British Government's proposal to build an RAF airstrip there.] B

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Abstracted also in IIOE Repr., 4: 1967, 867.

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1960 Exceptional rainfall at Singapore in December 1954 and Mahé, Seychelles, in January 1955. Met.Mag., 89: 93-94. [Text of a letter from McGaw to Thompson suggesting a connection between heavy rainfall in the two cases, with comments by Thompson.] LUA

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1941 The archipelago and Crown Colony of Seychelles. Can. geogr.J., 23: 300-307. P

MACKAY, W.
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1936 Note sur les cochenilles de l'île d'Agaléga. Revue agric. Ile Maurice, 152-153. E §

1941 Report on a few Coccidae (Homopt.) collected by Mr. P.O. Wiehe in the Chagos Archipelago. Bull.Maurit.Inst., 2: pt. 1, 38. [See also MAMET 1954b.] N §

1943 A revised list of Coccoidea of the islands of the western Indian Ocean south of the equator. Bull.Maurit.Inst., 2: pt.3, 137-170, 2 pl. [Contained a classified list and a map of the islands.] N §

1954a The ants of the Mascarene Islands. Bull.Maurit.Inst., 3: pt.4, 249-259. [Included four Seychelles species.] N §

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1957 A revised and annotated list of the Hemiptera (Heteroptera and Homoptera, excluding Sternorhyncha) of Mauritius. Bull. Maurit.Inst., 5: pt.2, 31-81. [Included species from Aldabra, Assumption, Cosmoledo and Seychelles.] N §

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1960 La cuisine seychelloise. Victoria, Saint-Fidèle. [Recipes in English.] ns u §
Second edition, 1968. C §

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1971 Seychelles: ultima speranza della condizione umana. Bergamo, D'Arte Rassegna. [Contained information on geography, geology, natural history, economy and people of Aldabra, Amirantes and Seychelles.] ns it nl §

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1962 Stomatopod Crustacea collected by the Yale Seychelles Expedition, 1957-1958. Postilla, no.68, 1-15. N §

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1903 Steinkorallen [of the German Deep-sea Expedition]. Valdivia Rep., 7: 1904, 261-318, 5 pl. Z

MAROVA, N.A.
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MARRIOTT, W.
1914 Meteorology in the British Crown Colonies, 1912. Q.Jl R. met.Soc., 40: 244-246. [Monthly and annual summaries of precipitation; included Seychelles.] LUTI

MARSHALL, N.B.
1956 See BERTELSEN.

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1933 La distribuzione geographica delle Pandanaceae. Memorie Soc.tosc.Sci.nat., 43: 190-209. N

Von MARTENS, E.
1869a Uebersicht der ostafrikanischen Süsswasser-Fische. Deckens Reisen, 3: pt.1, 141-144. Z

1869b Uebersicht der Land und Süsswasser-Mollusken der ostafrikanischen Küste von Cap Guardafui bis Port Natal nebst den nächtsliegenden Inseln. Deckens Reisen, 3: pt.1, 148-160. Z

1870 Die Ophiuriden des indischen Oceans. Arch.Naturgesch., 36: 244-262. N

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1896 Mollusken [of the Decken expeditions]. Deckens Reisen, 3: pt.1, 53-66, 3 pl. Z

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1902 Einige neue Arten von Meer-Conchylien aus den Sammlungen der Deutschen Tiefsee-Expedition. Sber.Ges.naturf.Freunde Berl., 237-244. N

Von MARTENS, E. and THIELE, J.
1903 Die beschalten Gastropoden der Deutschen Tiefsee-Expedition 1898-1899. Valdivia Rep., 7: 1-180, 9 pl. Z

Von MARTENS, E. and WIEGMANN, F.
1898 Land und Süsswasser-Mollusken der Seychellen. Mitt.zool. Mus.Berl., 1: 1-96, 4 pl. [Collected by A.Brauer, mainly from Mahé and Silhouette, Seychelles.] LUTM

MARTIN, R.
1894 Mission scientifique de M. Ch.Alluaud aux îles Séchelles: odonates. Annls Soc.ent.Fr., 64: 1895, 349-352. N

1896 Odonates des îles Séchelles. Mém.Soc.zool.Fr., 9: 101-112. [Twenty species described, including five new.] LUZ

MARTIN, W.R.
1884 See GREAT BRITAIN: ADMIRALTY.

MARTIUS. See De MARTIUS.

MASI, L.
1917 Chalcididae of the Seychelles Islands. With an appendix on Centrobia mahensis by KIEFFER, J.J. Novit.zool., 24: 121-230. [Collected by the Sladen Expedition.] P

MASSEE, G.
1892 Vanilla disease. Kew Bull., 111-120, 1 pl. [Calospora vanillae: description and prevention.] N §

MAST, H.
1910 Die Astrosphaeriden [of the German Deep-sea Expedition]. Valdivia Rep., 19: pt.1, 123-190, 8 pl. Z

MATHEWS, D.O.
1959 Report on the tourist industry of Seychelles and the future development of that industry. Mimeographed. [Contained recommendations.] C §

MATTHAI, G.
1914 A revision of the recent colonial Astraeidae possessing distinct corallites. Trans.Linn.Soc.Lond.(Zool.), 17: 1-140, 38 pl. [In GARDINER, J.S. and others 1907-1936.] N §

1928 A monograph of the recent meandroid Astraeidae. In: Catalogue of the madreporarian corals, 7: 1-288, 72 pl. London, Trustees of the British Museum. [Included eleven Indian Ocean genera.] N

MATTHEW, K.C.
1932 Research work on an outbreak of malaria at Assumption and Aldabra Islands in 1930. Victoria, Government Printer. ns u §

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1962 See LONCAREVIC.

1963 Geological history of the Seychelles. J.Seychelles Soc., no.4, 1965, 1-7. K §

1964a See LAUGHTON.

1964b See LAUGHTON.

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MATTHEWS, D.H. and DAVIES, D.
1964 Geophysical studies of the Seychelles Bank. Phil.Trans. R.Soc., ser.A, 259: 1966, 227-239. [In HILL, M.N. and others. Found an underlying crust of continental type, with magnetic anomalies ascribed to dolerite intrusions.] LUC §

MATTHEWS, D.H. and REILLY, T.A.
1964 Disappointing interim palaeomagnetic results from the Seychelles. Nature, Lond., 203: 1160. [Rocks from orientated dolerite dykes were found to have unstable remanent magnetization.] N §
Also in IIOE Repr., 3: 1966, 816.

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1925 Physical oceanography [of the Sladen Expedition]. Trans. Linn.Soc.Lond.(Zool.), 19: 1926, 169-205, 4 pl. [In GARDINER, J.S. and others 1907-1936. Surface salinities and temperatures, serial temperature records, deep soundings and bottom temperatures.] N §

MATTHEWS, W.S.
1950 See ISLIP.

MATTHEWS, W.S., and PICKERING, G.B.
1960 Patchouli from the Seychelles. Trop.Sci., 2: 93-95. [Report on a sample from cuttings imported from Singapore.] LUA §

MATTINGLY, P.F. and BROWN, E.S.
1956 The mosquitoes (Diptera: Culicidae) of the Seychelles. Bull.ent.Res., 46: 69-110, 3 pl. [Described thirteen species, namely Uranotaenia (3), Taeniorhynchus (1), Aedes (5), Culex (4). Containhd an appendix which included Aldabra, Amirantes, Chagos and Coetivy, as well as other Indian Ocean islands. Photographs included Lodoicea.] LUTM §

MAULIK, S.
1913 Coleoptera, Chrysomelidae: Hispinae of the Seychelles. Trans.Linn.Soc.Lond.(Zool.), 16: 237-242. [In GARDINER, J.S. and others 1907-1936.] N §

1917 Cassidinae and Bruchidae (Coleoptera) from the Seychelles Islands and Aldabra. Ann.Mag.nat.Hist., ser.8, 19: 144-147. [Collected by the Sladen Expedition.] LUC

1929a Chrysomelid Coleoptera of the subfamilies Eumolpinae, Galerucinae and Halticinae from the Seychelles and other islands of the western Indian Ocean. Proc.Linn.Soc.Lond., sess.141, 21-22. [Abstract read by H.Scott.] LUZ

1929b Coleoptera, Chrysomelidae: Eumolpinae, Galerucinae and Halticinae [of the Sladen Expedition]. Trans.Linn.Soc. Lond.(Zool.), 19: 1931, 241-260. [In GARDINER, J.S. and others 1907-1936.] N §

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1892 Census of the Seychelles Islands, 1891. Port Louis, Central Printing Establishment. C §

MAURITIUS: METEOROLOGICAL SOCIETY. See METEOROLOGICAL SOCIETY OF MAURITIUS.

MAURITIUS: OBSERVATORY DEPARTMENT.
1953-1958 Meteorological observations and climatological summaries. Port Louis. [Included data on rainfall and wind from Agalegas and Chagos.] ns it: WALLACE, J.A., jr.

MAYR, E. and VAURIE, C.
1948 Evolution of the family Dicruridae (birds). Evolution, Lancaster, Pa., 2: 238-265. [Included D.aldebranus.] LUZ

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1965 New oceanic cheilodipterid fishes from the Indian Ocean. Bull.Mus.comp.Zool.Harv., 134: 261-274. LUZ
Also in IIOE Repr., 4: 1967, 307-320.

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1907 Some remarks on birds seen during the cruise of the 'Valhalla', RYS, 1905-1906. Avicult.Mag., ser.2, 5: 144-148, 1 pl. N

1908 Abbott's rail. Avicult.Mag., ser.2, 6: 219-221, 1 pl. N

1911 Hymenoptera, Diploptera [of the Sladen Expedition]. Trans. Linn.Soc.Lond.(Zool.), 15: 1912, 43-44. [In GARDINER, J.S. and others 1907-1936.] N §

Van MEER, P.P.C.
1965 Primitiae africanae: VI. A revision of the genus Pentadesma Sab. (Guttiferae). Bull.Jard.bot.Etat Brux., 35: 412-433. [P.butyracea from Seychelles on 414-424.] LUB §

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1957, 1961 A systematic review of the Indo-Australian Zosteropidae. Zoöl.Verh., Leiden, no.35, 1-204; no.50, 1-168, 4 pl. [Z. modesta from Seychelles mentioned on no.35, 21; map on no. 35, 4.] N

MEILLON. See De MEILLON.

MEISENHEIMER, J.
1905 Pteropoda [of the German Deep-sea Expedition]. Valdivia Rep., 9: 1-314, 36 pl. [In German.] Z

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1856 Contributions to the meteorology and hydrography of the Indian Ocean: I. A meteorological journal . . . for the month of March, 1853 . . . . Port Louis, Denny. [With charts and diagrams.] S

MELL, C.
1903 Die Landplanarien der madagassischen Subregion. Abh. senckenb.naturforsch.Ges., 27: 1905, 191-238, 3 pl. [In VOELTZKOW and others 1897-1905. Included some Seychelles species.] LUZ

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1909 Report on the marine Mollusca obtained by Mr. J.Stanley Gardiner, FRS, among the islands of the Indian Ocean in 1905. Trans.Linn.Soc.Lond.(Zool.), 13: 65-138, 1 pl. [In GARDINER, J.S. and others 1907-1936.] N §

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1963 See WASSERBURG.

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1964 The distribution of dissolved organic carbon in the western Indian Ocean. Deep Sea Res., 11: 757-765. [Results of work in RV 'Anton Bruun'. Concluded that carbon in the ocean is extremely stable and little changed by biological action.] LUO
Coll.Repr.Woods Hole oceanogr.Instn, no.1482. LUO
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1967 Weight-length relationships for certain scombroid fishes from the equatorial Indian Ocean. E.Afr.agric.For.J., 34: 1968, 165-169. T §

1970 See FORSTER.

MERRILL, E.D.
1917 An interpretation of Rumphius's Herbarium amboinense. Manila, Bureau of Printing. Included Lodoicea. N

MERTENS, R.
1934 Die Insel-Reptilien, ihre Ausbreitung, Variation und Artbildung. Zoologica, Stuttg., 32: no.84, 1-209, 6 pl. N

1966 Liste der rezenten Amphibien und Reptilien: Chamaeleonidae. Tierreich, 83: viii plus 1-37. [Chamaeleo tigris from Mahé and Praslin, Seychelles, on 28.] NL

METEOROLOGICAL OFFICE. See GREAT BRITAIN: AIR MINISTRY: METEOROLOGICAL OFFICE.

METEOROLOGICAL SOCIETY OF MAURITIUS.

[1853] Charts showing the prevailing winds in the Indian Ocean in March 1853. [Port Louis.] [Five charts showing direction and force of the wind.] S: in catalogue but missing

[1862] Daily synoptic weather charts of the Indian Ocean for the year 1861. [Port Louis.] [Fifteen charts.] S: in catalogue but missing

MEYRICK, E.

1910 Descriptions of microlepidoptera from Mauritius and the Chagos Isles. Trans.R.ent.Soc.Lond., 366-377. [Included two species from Chagos.] LUZ

1911 Tortricina and Tineina [of the Sladen Expedition]. Trans. Linn.Soc.Lond.(Zool.), 14: 263-307. [In GARDINER, J.S. and others 1907-1936.] N §

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1897 Die Terricolen des madagassischen Inselgebiets. Abh. senckenb.naturforsch.Ges., 21: 215-252. [In VOELTZKOW and others 1897-1905.] N

1918 Die ptychobranchen und diktyobranchen Ascidien des westlichen indischen Ozeans. Mitt.zool.Mus.Hamb., 35: pt.2, 1-74, 1 pl. N

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1919b Die krikobranchen Ascidien des westlichen indischen Ozeans: Didemniden. Mitt.zool.Mus.Hamb., 37: 1920, 1-74, 2 pl. LUC

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1828 Notes sur les rochers découverts dans l'archipel des îles Seychelles. Bull.Soc.géogr.Paris, ser.1, 10: 140-141. [Extract from journal of the 'Arthur'.] G

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1948 See SEYCHELLES: GOVERNMENT.

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1956 See BRUUN.

MIERS, E.J.
1884 Crustacea [of the voyage of the 'Alert']. Alert Rep., 513-575, 7 pl. Z

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1964 See NEPROCHNOV.

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1957-1959 Ascidiacea [of the Danish Deep-sea Expedition]. Galathea Rep., 1: 189-209, 1 pl. N

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1964 With 'Atlantis II' to the Indian Ocean. Oceanus, 10: 6-9, 12-13. [A very short account.] LUO

MILLER, G.S.
1902 Two new tropical old world bats. Proc.biol.Soc.Wash., 15: 243-246. [Nyctinomus pusillus collected in Aldabra by W.L.Abbott.] N

MILLER, J.A.
1963 See BAKER, B.H.

MILLER, J.A. and MUDIE, J.D.
1961 Potassium-argon age determinations of granite from the island of Mahé in the Seychelles Archipelago. Nature, Lond., 192: 1174-1175. [Suggested a late precambrian origin for the granitic islands of the archipelago, possibly as fragments torn from the African land mass.] N §
Also in IIOE Repr., 1: 1965, 517-520.
Abstracted in New Scient., 13: 1962, 41. N

MILLER, N.C.E.
1956 Two new species of Miridae from the Agalega Islands. Bull. Maurit.Inst., 3: pt.5, 317-320. N §

MILLIMAN, J.D.
1965 An annotated bibliography of recent papers on corals and coral reefs. Atoll Res.Bull., no.111, iii plus 1-58. [Contained some Indian Ocean items.] NL

MILLOT, J.
1952 La faune malgache et le mythe gondwanien. Mém.Inst.scient. Madagascar, ser.A, 7: 1-36, 5 pl. [Presented evidence against theories of Lemuria and Gondwanaland.] N

1953 Le continent de Gondwana et les méthodes de raisonnement de la biogéographie classique. Annls Soc.natn.Zool.Biol.anim., ser.11, 15: 185-219. ns u

MILLOT, L.
1911 See HERSCHER.

MILNE-EDWARDS, A. and BOUVIER, E.L.
1893 Sur une espèce nouvelle du genre Deckenia (Hilgendorf) recueillie par M. Alluaud aux îles Seychelles. Annls Sci. nat.Zool., ser.7, 15: 325-336. [A crab, D.alluaudi.] LUC

MILNE-EDWARDS, A. and OUSTALET, E.
1885 Observations sur la faune de la Grande Comore. C.r.hebd. Séanc.Acad.Sci.,Paris, 101: 218-222. [Concluded that a study of mammals and birds of the Great Comoro seemed to show that this and neighbouring islands had not been attached to Madagascar.] N

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1954 Endemic plants of the Seychelles. Pk Adm.,Johannesb., 6: 19-24. N §

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1955 See NAKAMURA.

1962 Present status of the tuna longline fishery in the Indian Ocean (1959). Proc.Symp.scombroid Fishes, mar.biol.Ass. India, Mandapam Camp, 1139-1145. N

1958 Study of the fishing condition of the yellowfin in the Indian Ocean, especially on the annual differences of the hooked-rate and size composition. Rep.Nankai reg.Fish.Res. Lab., 7: 59- . ns tt nl: WLSP

MIRRLEES, S.T.A.
1932 See BROOKS, C.E.P.

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1902 Die Pantopoden der Deutschen Tiefsee-Expedition, 1898-1899. Valdivia Rep., 3: 175-196, 7 pl. Z

MOBIUS, K. and PETERS, W.

1878 Liste des poissons collectionnés à Maurice et aux Seychelles par le Professeur-Docteur K.Möbius et classifiés par M. W. Peters. Trans.R.Soc.Arts Sci.Maurit., ser.B, 11: 1883, 49-58. [189 species listed.] N §

MOBIUS, K., RICHTERS, F. and Von MARTENS, E.

1880 Beiträge zur Meeresfauna der Insel Mauritius und der Seychellen. Berlin, Gutmann. [General description, water temperatures and Foraminifera were by Möbius.] N

MOHR, Erna.

1937 Revision der Centriscidae (Acanthopterygii Centrisciformes). Dana Rep., 1: no.13, 1-69, 2 pl. Z

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1963 Histoires de crocodiles. J.Seychelles Soc., no.3, 65-67. K §

1970 Essai sur les îles Seychelles: I. L'archipel. Bull. Madagascar, no.292, 727-737. NC §

MOISEEV, L.K.

1961 See LUKJANOV.

MOKIEVSKAJA, V.V.

1961 Some hydrochemical features of the northern part of the Indian Ocean. Okeanol.Issled., no.4, 50-61. [In Russian. Results of RV 'Vityaz'. Found two distinct subsurface water masses, Central and Arabian.] NL

Also in IIOE Repr., 1: 1965, 56-67. [With an untitled abstract in English; English title on xiii.]

MOLLER, Lotte.

1929 Die Zirkulation des indischen Ozeans auf Grund von Temperatur und Salzgehaltstiefenmessungen und Oberflächenstrombeobachtungen. Veröff.Inst.Meeresk.Univ.Berl., 21: 1-48. LUO

MONRO, C.C.A.

1937 Polychaeta [of the John Murray Expedition]. Mabahiss Rep., 4: 243-321. N

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1877 Orchideae. In BAKER, J.G. 1877.

MOORE, T.

1871 Pictures of Palm trees: Deckenia nobilis. Florist Pomol., 252-253. N

MOREAU, C.

1827 Situation, étendue, établissement civil et militaire et population des îles et îlots formant les dépendances de l'île Maurice (Ile-de-France). Géographie, ser.1, 8: 211-223. [Population of slaves in Seychelles on 72.] G

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1937 Bird-migration over the north-western part of the Indian Ocean, the Red Sea, and the Mediterranean. Proc.zool.Soc. Lond., ser.A, 108: 1938, 1-26. [Personal observations, discussion, summary.] LUZ

1957 Variation in the western Zosteropidae (Aves). Bull.Br.Mus. nat.Hist.(Zool.), 4: 309-433. [Indian Ocean island species were found to be less aberrant than those from elsewhere.] LUZ

1959 Conspectus and classification of the ploceine weaver-birds. Ibis, 102: 1960, 298-321, 443-471. [With a summary.] P

1960 The ploceine weavers of the Indian Ocean islands. J.Orn., Lpz., 101: 29-49. [Included Foudia aldebrana and F. seychellarum.] N

1966 The bird faunas of Africa and its islands. London, Academic Press. [Hypsipetes sp. in Aldabra and Seychelles, as well as Comoros, discussed on 349 and 365; Seychelles sunbird on 357.] LUZ

MORELET, A.

1860 Isles orientales de l'Afrique. Paris, Klincksieck. Séries conchyliologiques . . ., no.2. [Melania amoena from Seychelles described, and land and freshwater molluscs known from east African islands, including Seychelles, listed: 37-127. Material collected by E.Vesco.] N

1882 Observations critiques sur le mémoire de M. E.von Martens intitulé: Mollusques des Mascareignes et des Séchelles. J. Conch., Paris, ser.3, 22: 85-106. [See Von MARTENS 1880.] N

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1838 The Chagos Archipelago. Trans.Bombay geogr.Soc., 1: 307-310. G

1842 On the Seychelle Islands. Naut.Mag., 585-590, 676-682, 739-746. G

MORIARTY, H.A.

1891 Islands in the southern Indian Ocean, westward of longitude 80° east, including Madagascar. London, Admiralty: Hydrographic Department. [Especially 320-389. Supplemented by Anon. 1898a. See also GREAT BRITAIN: ADMIRALTY.] B

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1912 Hymenoptera, Ichneumonidae [of the Sladen Expedition]. Trans.Linn.Soc.Lond.(Zool.), 15: 169-179. [In GARDINER, J.S. and others 1907-1936.] N §

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1963 The birds of some islands in the Indian Ocean. Sea Swallow, 16: 68-79. [With comments by BOURNE, W.R.P.; Aldabra on 68-76.] N

MORROW, J.E., jr.

1959 Distribution of the blue marlin and black marlin in the Indo-Pacific. Bull.mar.Sci.Gulf Caribb., 9: 321-323. N §

1962 Marlins, sailfish and spearfish of the Indian Ocean. Proc. Symp.scombroid Fishes, mar.biol.Ass.India, Mandapam Camp, ser.1, 429-440. N

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1939 Report on the Echinoidea of the John Murray Expedition. Mabahiss Rep., 6: 1-28, 6 pl. N

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1961 See MILLER, J.A.

MULLER, G.W.

1898 Die Ostracoden [of Voeltzkow's first expedition]. Abh. senckenb.naturforsch.Ges., 21: 255-296, 7 pl. [In VOELTZKOW and others 1897-1905.] N

1905 Ostracoda [of the German Deep-sea Expedition]. Valdivia Rep., 8: 1906, 27-154, 21 pl. [In German.] Z

MULLER, Yvonne.

1957 Aventures d'une parisienne dans l'Océan indien. Paris, Pensée Moderne. ns it: Biblio 1957 §

MULLIN, M.M.

1965 Size fractionation of particulate organic carbon in the surface waters of the western Indian Ocean. Limnol. Oceanogr., 10: 459-462, 610-611. [Work of RV 'Anton Bruun'.] LUO

Coll.Repr.Woods Hole oceanogr.Instn, no.1592. LUO
Also in IIOE Repr., 5: 1968, 639-643.

1966 Selective feeding by calanoid copepods from the Indian Ocean. In: Some contemporary studies in marine science, 545-554. ns u
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MURAT, M.
1900 Gordon's Eden: or the Seychelles Archipelago. Port Louis, Central Printing Establishment. [A short pamphlet in a popular style.] C

MURRAY, G.
1893 A comparison of the marine flora of the warm Atlantic, Indian Ocean and Cape of Good Hope. Phycol.Mem., pt.2, no.11, 65-70. N

MURRAY, Sir J.
1880 On the structure and origin of coral reefs and islands. Proc.R.Soc.Edinb., 10: 505-518. N

1889 On marine deposits in the Indian, Southern and Antarctic Oceans. Scott.geogr.Mag., 5: 405-436, 1 pl. [With a map showing distribution of oceanic deposits in the Indian Ocean. Included analyses of samples.] LUC

1909 On the depth and marine deposits of the Indian Ocean, with descriptions of the deposit-samples collected by Mr. J. Stanley Gardiner in 1905. Trans.Linn.Soc.Lond.(Zool.), 13: 1910, 355-396, 3 pl. [In GARDINER, J.S. and others 1907-1936. With maps showing depths, marine deposits and percentages of calcium carbonate in deposits.] N §

MURRAY, Sir J. and PHILIPPI, E.
1908 Die Grundproben der Deutschen Tiefsee-Expedition. Valdivia Rep., 10: 77-206, 9 pl. Z

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1933 Pachypanchax, a new genus of cyprinodont fishes from the Seychelles Islands and Madagascar. Am.Mus.Novit., no.592, 1. P

NAFE, J.E.
1963 See HEEZEN.

NAGEON de LESTANG, E. See De LESTANG.

NAKAGOME, J.
1958 Morphometric comparison of yellowfin tuna from the western, middle and eastern parts of the Indian Ocean. Bull.Jap.Soc. scient.Fish., 24: 165-168. [In Japanese with English

translation; this title as given.]

1962 Seasonal variation of swimming layer of yellowfin tuna and big-eyed tuna in the Indian Ocean. Proc.Symp.scombroid Fishes, mar.biol.Ass.India, Mandapam Camp, ser.1, 785-792. [With a summary.] N

NAKAMURA, H., YABUTA, Y. and MIMURA, K.
1955 Long line tuna fishing grounds in the Indian Ocean. Proc. Indo-Pacif.Fish.Coun., sess.6, sect.2, 220-238. LUZ

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NASH, G.V.
1906 The coco de mer, or double coconut. Jl N.Y.bot.Gdn, 7: 7-11. [A general description.] N

NAUDIN, C.
1864 Le Pinus peuce et le Lodoicea sechellarum. Revue hort., 146-148. [Extracts from accounts given at the Linnean Society of London.] NL §

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1964 Vertical distribution and diurnal vertical migrations of the major zooplankton representatives of the northern part of the Indian Ocean. Trudȳ Inst.Okeanol., 64: 250-256. [In Russian.] NL
Also in IIOE Repr., 2: 1966, 610-616. [With an untitled summary in English; English title on ix.]

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1913 Neuroptera, Myrmeleonidae from the Indian Ocean. Trans. Linn.Soc.Lond.(Zool.), 16: 243-246. [In GARDINER, J.S. and others 1907-1936.] N §

NEPROCHNOV, J.P., COVYLIN, V.M. and MIKHNO, M.F.
1964 The results of seismic measurements of the earth's crust and thickness of sediments in the Indian Ocean. Int.geol. Congr., sess.22, group 3. ns tt nl: WLSP
Abstracted in ROY (ed.), Group discussions. [Work done during 31st, 33rd and 35th cruises of RV 'Vityaz'.]

NEUMANN, G.
1905 Doliolum. Valdivia Rep., 12: 1906, 95-243, 15 pl. [In German.] Z

1912 Die Pyrosomen der Deutschen Tiefsee-Expedition. Valdivia Rep., 12: 1913, 291-422, 13 pl. Z

NEUMANN, L.G.
1907 Note sur les Ixodidae recueillis dans des îles de l'Océan indien par M. J.Stanley Gardiner. Trans.Linn.Soc.Lond. (Zool.), 12: 193-196. [In GARDINER, J.S. and others 1907-1936. Described one species from Farquhar and two from Providence.] N §

NEUMAYR, M.
1885 Die geographische Verbreitung der Juraformation. Denkschr. Akad.Wiss., Wien (Math.-Nat.Kl.), 1: 57-143, 3 pl. [Evidence for a former land union between India and South Africa given on 132 and in pl.1.] N

NEVILL, G.
1868 Notes on some of the species of land Mollusca inhabiting Mauritius and the Seychelles. Proc.zool.Soc.Lond., 257-261. Z

1869 Additional notes on the land-shells of the Seychelles Islands. Proc.zool.Soc.Lond., 61-66. LUZ

1870 On the land shells of Bourbon, with descriptions of a few new species. J.Asiat.Soc.Beng., 39: pt.2, 403-416. [Included some Seychelles species.] N

1878-1884 Hand list of Mollusca in the Indian Museum, Calcutta. Calcutta, Indian Museum. 2 pt. N

NEVILL, G. and NEVILL, H.
1870 Descriptions of new Mollusca from the eastern regions. J. Asiat.Soc.Beng., 39: pt.2, 1871, 1-11, 1 pl. [Included Helix (Discus) levieuxi, Helix (Conulus) subturritula and Helicina theobaldiana from Mahé.] N

NEVILL, H.
1870 See NEVILL, G.

NEWMAN, K.B.
1965a Vanishing birds of the Seychelles. Animals, 5: 475-481. N §

1965b An outline report on the present-day status of birds and turtles in the Seychelles. Mimeographed. ns it: STODDART, D.R. 1967c

NEWMAN, T.H.
1908 The Madagascar turtle-dove. Avicult.Mag., ser.2, 6: 79-84, 1 pl. N

NEWMAN, W.A.
1967 A new genus of Chthamalidae (Cirripedia, Balanomorpha) from the Red Sea and Indian Ocean. J.Zool., 153: 423-435. [Tetrachthamalus oblitteratus from Aldabra and Seychelles, as well as the Red Sea coast, collected by the Yale Expedition.] LUZ

NEWNHAM, E.V.
1949 The climates of Addu Atoll, Agalega Islands and Tristan da Cunha. Prof.Notes met.Off.,Lond., 7: no.101, 1-20, 4 pl. LUTI

NEWSTEAD, R.
1909 Coccidae and Aleurodidae of Madagascar and Comoro Is. Wiss. Ergebn.Reise Ostafr.1903-5, 2: 349-356. [In VOELTZKOW and others 1906-1923. Icerya seychellarum West. on 354-355.] N

NEWTON, A.
1865 On an apparently undescribed bird from the Seychelle Islands. Ibis, ser.2, 1: 331-333, 1 pl. [Copsychus sechellarum.] N

1874 See HOOKER, Sir J.D.

1876 On the species of Hypsipetes inhabiting Madagascar and the neighbouring islands. Rowley's orn.Misc., 2: 41-54, 1 pl. [Included a colour plate of the Seychelles merle.] N

1879 Remarks on a specimen of Alectoroenas nitidissima exhibited by Dr. Traquair. Proc.zool.Soc.Lond., 2-4. [Exhibition and discussion of one of the only three known skins of the extinct Mauritius species of Dutch pigeon.] LUZ

NEWTON, A. and NEWTON, Sir E.
1876 On the Psittaci of the Mascarene Islands. Ibid, ser.3, 6: 281-289, 1 pl. [Included Coracopsis barklyi and Palaeornis wardi from Seychelles.] N

NEWTON, Sir E.
1867a On the land birds of the Seychelles Archipelago. Ibis, ser.2, 3: 335-360, 1 pl. [With a list of species and a table of distribution.] N

1867b Descriptions of some new species of birds from the Seychelles Islands. Proc.zool.Soc.Lond., 344-347, 1 pl. [Seven species, with a colour plate of the Seychelles black parrot.] N

1876 See NEWTON, A.

1888 Presidential address to the Norfolk and Norwich Naturalists' Society, 1888; with appendix: List of the birds of the Mascarene Islands, including the Seychelles. Trans.Norfolk Norwich Nat.Soc., 4: 1889, 537-554. [Also showed the distribution.] N

NEWTON, R.B.
1889 See BARON.

NICOLL, M.J.
1906a Remarks on some species of birds collected during the recent voyage of RYS 'Valhalla'. Bull.Br.Orn.Club, 16: 102-109. [Included species from Aldabra, Assumption and Seychelles as well as Glorioso.] N

1906b On the birds collected and observed during the voyage of the 'Valhalla' RYS from November 1905 to May 1906. Ibis, ser.8, 6: 666-712, 1 pl. [Birds from Aldabra and Seychelles groups on 692-710.] N

1908 Three voyages of a naturalist, being an account of many little-known islands in three oceans visited by the 'Valhalla' RYS. London, Witherby. [Included Aldabra, Assumption and Seychelles.] Z §

NIEDEN, F.
1913 Gymnophiona (Amphibia Apoda). Tierreich, 37: ix plus 1-31. [In German. Contained Seychelles species.] N §

NIEJAHR, Capt.
1876 Aus den Reiseberichten der Brigg 'Hermann Friedrich', Capitain Niejahr. Annln Hydrogr.Berl., 4: 243-250. [Visited Cosmoledo in 1875.] M §

NIELSEN, E.S.
1939 Die Ceratien des indischen Ozeans und des ostasiatischen Gewässer. Dana Rep., 3: no.17, 1-33. Z

1962 On the biology of the Indian Ocean. ICSU Rev., 4: 9-13. S

NIEREMBERG, J.E.
1635 Historia naturae . . . . Antwerp, Moreto. ["De cocco Maldivensi" (coco-de-mer nut) in 14: ch.9, 298.] N

NIGRINI, Catherine.
1967 Radiolaria in pelagic sediments from the Indian and Atlantic Oceans. Bull.Scripps Instn Oceanogr.tech.ser., 11: 1-106, 9 pl. ns tt: WLSP
Also in IIOE Repr., 6: 1969, 657-785.

NILSSON-CANTELL, C.A.

1929 Cirripedien der Genus Verruca der Deutschen Tiefsee-Expedition auf dem Dampfer 'Valdivia' 1898-1899. Zool.Jb., 58: 459-480. [Verruca intexta on 468-470.] N

1938 Cirripedes from the Indian Ocean in the collection of the Indian Museum, Calcutta. Mem.Indian Mus., 13: 1-81, 3 pl. [Distribution, growth, systematics.] LUZ

"N.M.S."

1967 Aldabra. IUCN Bull., new ser., 2: 32. [A plea for conservation.] N §

NOBLE, G.K.

1926 An analysis of the remarkable cases of distribution among the Amphibia, with descriptions of new genera. Am.Mus.Novit., no.212, 1-24. [Seychelles Pelobatidae discussed on 8-12.] P

NORMAN, J.R.

1939 Fishes [of the John Murray Expedition]. Mabahiss Rep., 7: 1-116. N

NORTH, Marianne.

1892 Recollections of a happy life. Edited by Mrs. J.A.Symonds. London, Macmillan. 2 vol. [Seychelles in 2: 284-309.] B §

1893 The Seychelles. Pall Mall Gaz., 21 January. [See note to Anon. 1883.] ns it: YULE and BURNELL, 231

NYBELIN, O.

1957 Deep-sea bottom fishes [of the Swedish Deep-sea Expeditions]. Albatross Rep., 2: 250-345, 7 pl. [Indian Ocean species on 307 and 310.] N

NYE, I.W.B.

1959 Report on the control of Malittomma insulare Fairm. (Coleoptera, Lymexylonidae) attacking coconut palms in Seychelles. [Victoria, Government Printer?] E §

1960 Seychelles: review of the work on economic entomology. Rep. Commonw.ent.Conf., sess.7, 343-344. London, Commonwealth Institute of Entomology. N §

1961a The control of the coconut pest Melittomma insulare (Coleoptera, Lymexylidae) in Seychelles. Bull.ent.Res., 52: 489-499. [Reported results of treating infected trees with coal tar and creosote.] LUTM §

1961b Second report on the control of Malittomma insulare (Coleoptera, Lymexylidae) and other pests attacking coconut palms in Seychelles. Mimeographed. [Included reference to Oryctes, Pseudococcus and some coccids.] E §

OBERTHUR, C.
1879 Catalogue raisonné des Papilionidae de la collection de Ch. Oberthür à Rennes. Etud.Ent., 4: 1-117, 6 pl. [P.disparilis nana Oberthür from Seychelles on 54.] N

ODHNER, N.H.
1960 Brachiopoda [of the Swedish Deep-sea Expedition]. Albatross Rep., 2: 403-406. N

OLAVSSON, E.
1960 Descriptions of sediment cores from the Indian Ocean. Albatross Rep., 9: 53-88, 18 pl. N

OLIVER, D. (ed.).
1894 Hooker's Icones plantarum: . . . , ser.4, 4: pt.1-2. London, Dulau, 1895. [Imbricaria sechellarum (Sapotaceae), pl.2315; Euphorbia abbottii (Euphorbiaceae), pl.2347.] N

OLIVER, S.P.
1892 Barré and the discovery of the coco-de-mer. Gdnrs' Chron., 21 May, 649-650. [Attributed the discovery of the true source of the nuts, which had been thought to come from trees submerged in the sea, or from even more mythical places, to Captain Marion de Fresne's engineer officer, who made the first detailed survey of Seychelles, and visited Praslin in 1769 where he saw the palms growing.] N §

OMMANNEY, F.D.
1949-1950. See PETERS, A.J.

1952 The shoals of Capricorn. London, Longman. Z §
I bianchi del Capricorno. Milan, Martello. ns

1953a Note on meteorology. In WHEELER and OMMANNEY.

1953b See WHEELER.

1965 A draught of fishes. London, Longman. [Ch.4 dealt with the Mauritius-Seychelles Fisheries Survey of 1948-1949, more fully reported in WHEELER and OMMANNEY.] P §

ORIAN, A.J.E.
1959 Report on a visit to Diego Garcia. Revue agric.sucr.Ile Maurice, 38: 127-143, 1 pl. [Mainly about coconut culture and the rhinoceros beetle.] T

ORLOV, V.M.
1964 See POPOV.

ORMOND, R.F.G. and CAMPBELL, A.C.
1970 Observations on Acanthaster planci and other coral reef echinoderms in the Sudanese Red Sea. Symp.zool.Soc.Lond., no.28, 1971, 433-454, 554. [In STODDART, D.R. and YONGE (eds.). Referred to reports of the crown-of-thorns starfish being found in Aldabra and Seychelles. With a synopsis, and a note added in proof.] LUZ

De ORTA, G. (Ab HORTO, G.).
1563 Coloquios dos simples, e drogas, he cousas mediçinais da India . . . . Goa, Ioannes. [Dialogues on a variety of scientific subjects. Mentioned coco-de-mer nuts, which were thought to have come from fossil trees on submerged land connecting India with the Maldives. The alleged medicinal properties of the nut were described sceptically.] N

Another edition, 1872. Lisbon, Impresa Nacional. ns it: YULE and BURNELL; FAUVEL, A.A. 1915

Aromatum et simplicium aliquot medicamentorum apud Indos nascentium historia. Translated by Carolus Clusius (Charles de l'Ecluse). Fourth edition, 1593. Antwerp, Moretum. [Medicinal properties in bk.1, 102, 107-110.] ns it: FAUVEL, A.A. 1915

Also in: Carolii Clusii atrebatis exoticorum libri decem, bk.7, 145-252. Raphelengi, 1605. ["Coccus de Maldiva" on 190-192.] N

See also ACOSTA.

ORTMANN, A.E.
1902 The geographical distribution of freshwater decapods and its bearing upon ancient geography. Proc.Am.phil.Soc., 41: 267-400. Z

OUSTALET, E.
1877 Descriptions de quelques espèces nouvelles de la collection ornithologique du Muséum d'Histoire Naturelle. Bull.Soc. philomath.Paris, ser.7, 1: 98-107. [Included species from De l'Isle's collection not described in NEWTON, Sir E. 1867a.] N

Reviewed in Ibis, ser.4, 3: 1879, 97. N

1878 Etude sur la faune ornithologique des îles Seychelles. Bull.Soc.philomath.Paris, ser.7, 2: 161-206. [Described forty-four species in Lantz's collection.] N

1885 See MILNE-EDWARDS.

OVCINNIKOV, I.M.
1961 Circulation of waters in the northern part of the Indian Ocean during the winter monsoon. Okeanol.Issled., no.4, 18-24. [In Russian. Results of RV 'Vityaz'.] NL
Also in IIOE Repr., 1: 1965, 24-30. [With an untitled abstract in English; English title on xiii.]

OWEN, Sir R.
1857 Description of a new species of Euplectella (Euplectella cucumer, O.). Trans.Linn.Soc.Lond. 22: 117-123, 1 pl. [Described a single sponge specimen from Seychelles.] LUB

1874 See HOOKER, Sir J.D.

OWEN, W.F.W.
1832 On the geography of the Maldive Islands. J.R.geogr.Soc. Lond., 2: 81-92. [Described currents and tides in the Indian Ocean.] N

1833 Narrative of voyages to explore the shores of Africa, Arabia and Madagascar; performed in HMS 'Leven' and 'Barracouta'. Edited by H.B.Robinson. London, Bentley. 2 vol. [Seychelles in 2: ch.14-16.] Z

OXFORD AND ASQUITH, Earl of.
1965 The value of the expedition. Animals, 8: 75-76. [The Bristol University Seychelles Expedition 1964-1965.] N §

OZANNE, J.A.F.
1936 Coconuts and creoles. London, Allan. [A one-sided popularly written account.] C §

OZAWA, K.
1965 See UEDA.

OZAWA, K. and SENO, J.
1965 General report of the participation of Japan in the International Indian Ocean Expedition: V.8. Eye observation. Rec.oceanogr.Wks Japan, new ser., 8: 1966, 113-118. [In HIDAKA and others (eds.). Mainly reported insects, flying fish, skipjack schools and birds seen in 1962, 1963 and 1964 between Chagos and Western Australia.] LUO

PAJOT, Elie.
1876 Les Seychelles. ns it: FAUVEL, A.A. 1915, 304 [where the reference was given incorrectly as Exploration, 3: 523-526]

PALMER, D.
1933 The beautiful Seychelles Islands. Crown Colon., 3: 417-418. [A short popular account.] C

PALOMBELLI, F.
1954 L'isola delle Tartarughe. Epoca, 14: 7 March, 42- . [Aldabra birds and giant tortoise.] ns tt nl: Ulrich §

PANIKKAR, N.K.
1963 The Indian Ocean Expedition. Curr.Sci., 32: 49-53. N

1966 Fishery resources of the Indian Ocean. Curr.Sci., 35: 451-455. LUC
Also in IIOE Repr., 5: 1968, 374-378.

PARIS, E.
1835 Les Seychelles. Favorite Rep., 1: 133-158. B

PARKER, F.F.
1948 See PETERS, A.J. 1948-1949.

PARKER, H.W.
1936 Revised list of reptiles (excluding chelonians) and amphibians collected in the Seychelles. Trans.Linn.Soc. Lond.(Zool.), 19: 444-446. [In GARDINER, J.S. and others 1907-1936.] N §

1941 The caecilians of the Seychelles. Ann.Mag.nat.Hist., ser. 11, 7: 1-17. [Revision of the taxonomy.] LUZ

1947 See VESEY-FITZGERALD.

1958 Caecilians of the Seychelles Islands with a description of a new subspecies. Copeia, no.2, 71-76. N §

PARKER, I.S.C.
1970 Some ornithological observations from the western Indian Ocean. Atoll Res.Bull., no.136, 211-220. [In STODDART, D.R. (ed.) 1970. With a summary.] NL §

PARKINSON, J.
1640 Theatrum botanicum . . . an herball of a large extent . . . . London. [In Latin. Repeated myths about "coccus de Maldiva" (coco-de-mer nut) on 1598-1600.] N

PARR, A.E.
1960 The fishes of the family Searsidae. Dana Rep., 9: no.51, 1-109. Z

PARSONS, H.A.
1950 The Colonial coinages of British Africa with the adjacent islands. London, Spink. [Seychelles in ch.6.] C §

PARSONS, J.J.
1962 The green turtle and man. Gainesville, University of Florida Press. University of Sussex §

PARTHASARATHY, K.
1961 International Indian Ocean Expedition. Bull.Wld Hlth Org., 10: 228-229. B

PASSMORE, W.M.
1971 See GREAT BRITAIN: ADMIRALTY 1891.

PATIN, S.A.
1964 See POPOV.

PATON, J.
1936 The John Murray Expedition 1933-34: scientific reports: report on the meteorological observations. Mabahiss Rep., 2: 1-14. N

PAULIAN, R.
1959 L'environnement insulaire de Madagascar et le peuplement des îles océaniques. Colloques int.Cent.natn.Rech.scient., no. 94, 1961, 261-271. [Discussed the distribution of mainly isopods, insects and birds in Agalegas, Aldabra group, Chagos, Coetivy, Farquhar, Providence and Seychelles.] S

1961 La zoogéographie de Madagascar et des îles voisines. Faune Madagascar, 13: 1-485, 23 pl. R

1967 See VINSON.

PAVLOV, V.M.
1961 Optical properties of the main water masses in the northern part of the Indian Ocean. Okeanol.Issled., no.4, 44-49. [In Russian. Results of RV 'Vityaz'. High transparency found.] NL
Also in IIOE Repr., 1: 1965, 50-55. [With an untitled abstract in English; English title on xiii.]

PAX, F.
1909 Die Aktinien der ostafrikanischen Inseln. Wiss.Ergebn. Reise Ostafr.1903-5, 2: 399-418, 3 pl. [In VOELTZKOW and others 1906-1923. Chagos and Seychelles species mentioned.] N

PEAKE, J.F.
1969 The evolution of terrestrial faunas in the western Indian Ocean. Phil.Trans.R.Soc., ser.B, 260: 1971, 581-610. [In WESTOLL and STODDART, D.R. (org.).] LUC §

1970 See STODDART, D.R.

1971 Non-marine Mollusca of Diego Garcia. Atoll Res.Bull., no. 149, 173-174. [In STODDART, D.R. and TAYLOR, J.D. (eds.).] NL §

PEARSON, J.O.
1965 The Garden of Eden. Africana, 2: no.4, 45-47. [Believed by General C.G.Gordon to have been the Vallée de Mai, Praslin, Seychelles, home of the coco-de-mer palm.] NC §

PEASE, A.K.
1966 See RYTHER.

PELLEGRIN, J.
1922 Les poissons des eaux douces de la région madécasse. C.r. Ass.fr.Avanc.Sci., sess.46, 417-419. [A preliminary list; see also PELLEGRIN 1932.] N

1932 Les poissons des eaux douces de la région madécasse. C.r. Ass.fr.Avanc.Sci., sess.56, 475-477. [A revision of the earlier list in PELLEGRIN 1922.] N

1933 Les poissons des eaux douces de Madagascar et des îles voisines (Comores, Seychelles, Mascareignes). Mém.Acad. malgache, 14: 1-223, 3 pl. N §

PELLY, L.
1865 On the island of Mahi, Seychelles. J.geogr.Soc.Lond., 35: 231-237. Z §

PELTE, S.
1952 See ROUNTREE.

PENDAL, L.E.
1942 See GREAT BRITAIN: AIR MINISTRY: METEOROLOGICAL OFFICE 1940-1943.

PENNY, C. Mary.
1968 See GAYMER.

PENNY, M.J.
1965a Bristol University Seychelles Expedition: II. Studying the rare birds of Cousin. Animals, 7: 58-59. N §

1965b Bristol University Seychelles Expedition: III. The black parrots of Praslin. Animals, 7: 184-187. N §

1965c Bristol University Seychelles Expedition: IV. The Seychelles black paradise flycatcher. Animals, 7: 304-306. [Endemic in La Digne.] N §

1965d Bristol University Seychelles Expedition: V. The birds of Aldabra. Animals, 7: 409-411. N §

1965e See GAYMER.

1967 A new sanctuary in the Seychelles. Oryx, 9: 214-216, 1 pl. [Announced a plan for ICBP to buy Cousin.] LUZ §

1968a Endemic birds of the Seychelles. Oryx, 9: 267-275. [Ten species described, with suggestions for conservation.] LUZ §

1968b See BENSON.

1968c Cousin Island. Times, Lond., 27 January. ns tt

1968d See GAYMER.

1969a See BENSON.

1969b Migrant waders at Aldabra, September 1967-March 1968. Phil.Trans.R.Soc., ser.B, 260: 1971, 549-559. [In WESTOLL and STODDART, D.R. (org.). With an abstract.] LUC §

1971a Cousin Island: the first year. Animals, 13: 880-885. [Purchased by the British sections of ICBP and WWF in 1968; see also LOUSTAU-LALANNE 1968.] NL §

1971b Report on Cousin Island. Cousin Island Nature Reserve: second report to subscribers. Oxford, Church Army Press. [First report was by LOUSTAU-LALANNE 1968.] ns u §

PENNY, M.J. and DIAMOND, A.W.
1969 The white-throated rail Dryolimnas cuvieri on Aldabra. Phil.Trans.R.Soc., ser.B, 260: 529-548. [In WESTOLL and STODDART, D.R. (org.). With an abstract.] LUC §

PERCY, R., Lord.
1958 See RIDLEY, M.W.

1966 See RIDLEY, M.W.

1970 Cousin Island Nature Reserve in the Seychelles, Indian Ocean. Biol.Conserv., 2: 225-227. [Bought by ICBP in 1968; an account of its possibilities, with recommendations.] LUZ §

PEREZ, J.
1894 Mission scientifique de M. Ch.Alluaud aux îles Séchelles: hymenoptères. Annls Soc.ent.Fr., 64: 1895, 205-212. N

PERKINS, B.L.
1965 Angraecum brongniartianum Rchb.F.ex Linden. Orchid Rev., 73: 57-58. K

PERRIER, E.

1869 Recherches sur les pédicellaires et les ambulacres des astéries et des oursins. Annls Sci.nat.Zool., ser.5, 12: 197-304, 2 pl. [Ophidiaster purpureus on 253-254, Goniodiscus articulatus on 279-280, both from Seychelles.] LUC

1875-1876 Revision de la collection de stellérides du Muséum d' Histoire Naturelle de Paris. Archs Zool.exp.gén., 4: 1875, 265-450; 5: 1876, 1-104. [Anthenea articulata on 5: 89-90; Ophidiaster purpureus on 4: 392; both from Seychelles.] N

PESCHET, R.

1917 Coleoptères des îles Mascareignes et Séchelles: missions scientifiques de MM. Ch.Alluaud (1892, 1893 et 1897) et P.Carié (1910-1913): Dytiscidae et Gyrinidae. Annls Soc. ent.Fr., 86: 1-56. N

PETERS, A.J.

1950 Rural science in Seychelles primary schools: a guide for teachers. Victoria, Department of Education. Mimeographed. LUE §

1957 Bibliography of published work bearing on the natural history of the Seychelles and neighbouring archipelagoes. J.Soc. Biblphy nat.Hist., 3: 238-262. [Items were in chronological order after classification first under subject and then under taxonomic headings, with an index of authors' names. Items included in major expedition reports were not separately listed.] Z §

PETERS, A.J., LANIER, G., OMMANNEY, F.D. and WHEELER, J.F.G.

1949-1950 Mother earth. Victoria, Government Printer. [Six broadcast talks printed separately as suppl. to Seychelles Govt Bull.] ns it §

PETERS, A.J., PARKER, F.F. and SAUVAGE, A.

1948-1949 Space and time. Victoria, Government Printer, 1949. [Eleven broadcast talks originally printed separately as suppl. to Seychelles Govt Bull., collected and reprinted together as a booklet.] C §

PETERS, W.

1868 Uber die zu den Glossophagae gehörigen Flederthiere und über eine neue Art der Gattung Coleura. Mber.preuss.Akad.Wiss., 1869, 361-368, 1 pl. [Described Coleura seychellensis.] N

1876 Ubersicht der von Hrn.Prof.Dr.K.Möbius in Mauritius und bei den Seychellen gesammelten Fische. Mber.Preuss.Akad.Wiss., 1877, 435-447. N

1877 Sammlung des Hrn.Prof.Dr.K.Möbius auf den Maskarenen und Seychellen. Mber.preuss.Akad.Wiss., 1878, 455-457. [Described three species of Amphibia and six of Reptilia from Seychelles.] N

1878 See MOBIUS.

PETERS, W.C.H.
1869 Säugethiere und Amphibien [of the Decken expeditions]. Deckens Reisen, 3: pt.1, 1-18, 6 pl. Z

PETERSON, R.T.
1968 A plea for a magic island. Audubon Mag., 70: no.1, 50-51. [Aldabra.] N

1970 Wildlife. In: Forgotten islands of the Indian Ocean, 8-9. London, BOAC. [Article in an advertising brochure for a series of cruises.] ns it §

PETLEY, W.H.
1884 See GREAT BRITAIN: ADMIRALTY.

PETRUSHEVSKAYA, M.G.
1967 Radiolaria in the plankton and recent sediments from the Indian Ocean and Antarctic. In FUNNELL and RIEDEL (eds.), 319-329. [With a summary.]

PETTERSSON, H.
1934a The "Johannes Schmidt" Ridge in the Indian Ocean. Nature, Lond., 134: 29. [A letter to the editor suggesting this name for the ridge between Chagos and Socotra discovered by the John Murray Expedition (see SEWELL and others).] LUC

1934b The ridge in the Indian Ocean between the Chagos Is. and Socotra. Nature, Lond., 134: 536. [A letter to the editor replying to that of TÅNING and repeating the suggestion in his earlier letter on 29 (PETTERSSON 1934a).] LUC

1949 Exploring the bed of the ocean. Nature, Lond., 164: 468-470. [Discussion of results of the 'Albatross' expedition.] LUC

1951 Die swedische Tiefsee-Expedition 1947/1948. Naturwissenschaften, 38: 125-128. [In the 'Albatross'.] N

1953 The Swedish Deep-sea Expedition, 1947-48. Deep Sea Res., 1: 17-24, 1 pl. [Summarized results of the cruise of the 'Albatross'.] LUO

1954 Westward ho with the 'Albatross'. London, Macmillan. G

1957 The voyage [of the Swedish Deep-sea Expedition]. Albatross Rep., 1: 1-123. N

PETTERSSON, H. and others.
1951-1967 Reports of the Swedish Deep-sea Expedition 1947-1948. ["Albatross Rep."] Göteborg, Kungliga Vetenskaps-och Vitterhetssamhälle. 10 vol. N

PEYERIMHOFF. See De PEYERIMHOFF.

PHILIP, HRH Prince, Duke of Edinburgh, and FISHER, J.M.M.
1970 Wildlife crisis. London, Hamilton; New York, Cowles. [With colour plates of the Seychelles kestrel and magpie robin. Indian Ocean islands on 176.] N §

PHILIPPI, E.
1908 See MURRAY, Sir J.

PHILLIPS, T.A.
1964 See INMAN.

PICAULT, L.
1742-1744 [Extracts from unpublished reports of voyages to Indian Ocean islands.] In FAUVEL, A.A. 1900a. [With commentary by Fauvel.]

1743 [Carte des îles Praslin, Curieuse et Ronde, ou vivent les cocos de mer.] In FAUVEL, A.A. 1915. [Reprint of original maps by the second known visitor to Seychelles, to whom is usually attributed the discovery of Mahé in 1742 and Praslin in 1743.]

PICHI-SERMOLLI, R.E.G.
1954 See BECCARI.

PICHON, M.
1949 Revision des apocyanacées des Mascareignes et des Séchelles. Mém.Inst.scient.Madagascar, ser.B, 2: pt.1, 33-44. [Described five Seychelles species.] N

PICHON, X. See Le PICHON.

PICKERING, G.B.
1960 See MATTHEWS, W.S.

PICKFORD, Grace E.
1946 Vampyroteuthis infernalis Chun: an archaic dibranchiate cephalopod: I. Natural history and distribution. Dana Rep., 5: no.29, 1-40. Z

1949 Vampyroteuthis infernalis Chun: an archaic dibranchiate cephalopod: II. External anatomy. Dana Rep., 6: no.32, 1-132. Z

1959 Vampyromorpha [of the Danish Deep-sea Expedition]. Galathea Rep., 1: 243-253. N

PIGAFETTA, A.

1519-1522 [Primo viaggio intorno al mondo.] Printed, translated and edited by J.A.Robertson from the manuscript in the Biblioteca Ambrosiana, Milan, as: Magellan's voyage around the world by Pigafetta. Cleveland, Clark, 1906. 3 vol. [Thought by FAUVEL, A.A. 1915, 171-174, to contain the first known reference to the coco-de-mer palm, in semi-mythical tales told to the travellers in 1522 whilst in Timor, Java, probably originating from the finding of nuts washed ashore in the Maldives or Sumatra. In 2: 170-171, enormous birds called "garuda" were said to live in "a very huge tree" called "cam panganghi" having a fruit called "bua panganghi", "larger than a cucumber", and growing at a place called "Puza thaer". "The Moros of Burne whom we had in our ship told us that they had seen them, for their king had had two of them sent to him from the kingdom of Siam".] LUC

Navigation et descouurement de la Inde superieure et isles de Malucque ou naissent les cloux de Girofle . . . . Printed in facsimile, translated and edited by R.A.Skelton from the "Nancy" manuscript in the Beinecke Library at Yale University, as: Magellan's voyage: a narrative account of the first circumnavigation. New Haven and London, Yale University Press, 1969. 2 vol. ["Garuda", "Puzzathaer", "Caiupangganghi" and "Buapangganghi" on 1: 142, 144 and in 2:.] LUC

Numerous earlier editions, of which the following are examples:

Le voyage et nauigation faict par les Espaignolz es Isles de Mollucques. [Translator not known.] Paris, Colines, 1526- . ns it: Skelton

Primo viaggio intorno al globo terracqueo . . . . Edited by C.Amoretti. Milan, 1800. ns it: Skelton

The first voyage round the world by Magellan . . . . Translated by Lord Stanley of Alderley. London, Hakluyt Society, 1874. [154-155.] LUC

PIGGOTT, C.J.

1961a Notes on some of the Seychelles Islands, Indian Ocean. Atoll Res.Bull., no.83, 1-10. [Mainly about Alphonse, Astove, Desnoeufs and St. Pierre.] N §

1961b The problems of coconut production on Seychelles "outer islands". E.Afr.agric.For.J., 27: 127-130. N §

1961c A report on a visit to the outer islands of Seychelles between October and November 1960. Tolworth, Ministry of Overseas Development: Directorate of Overseas Surveys: Land Resources Division. ns it: STODDART, D.R. 1970a §

1962 The outlying islands of Seychelles. J.Seychelles Soc., no. 2, 44-48. K §

1968 A soil survey of Seychelles. Tolworth, Ministry of Overseas Development: Directorate of Overseas Surveys: Land Resources Division. ns it: BAYNE et al. 1970b §

PIKE, N.

1871 A visit to the Seychelles Islands. Commercial gazette of Port Louis. [Frigate, Mahé and Praslin.] ns it: FAUVEL, A.A. 1915, 277-278

Also in Trans.R.Soc.Arts Sci.Maurit., ser.B, 6: 1872, 83-142. N

1873 Sub-tropical rambles in the land of the Aphanapteryx. London, Sampson Low. [Agalegas, Aldabra group, Amirantes, Chagos, Coetivy and Seychelles in ch.25.] C §

PILLAY, P., LOW NAM, A., ELIZABETH, J. and POOL, G.

1970 Figures about the coco-de-mer palms. Young Scientist (magazine of the Young Scientists' Society of Seychelles College), no.3, 14-16. [First-hand observations by secondary-school pupils.] C §

PINHEY, E.C.G.

1967 See BLACKMAN.

PISO, W.

1650 Mantissa aromatica sive de aromatum cardinalibus quatuor, et plantis aliquot Indicis in medicinam receptis, relatio nova. Amsterdam, Elzevier. [Related myths about the origin and medicinal properties of the coco-de-mer nut, called "nux medica Maldivensis", on 203-226.] N

PITMAN, W.C., III.

1967 See HEIRTZLER.

PITOT, A.

1899 L'île de France: esquisses historiques (1715-1810). Port Louis, Pezzani. [Seychelles in pt.1, chs.3 and 5.] C

1905 T'eylandt Mauritius: esquisses historiques (1598-1710). Port Louis, Coignet. ["Extrait d'un portulan, 1546", facing 4, showed western Indian Ocean islands.] C

PITOU, L.A.

1805 Voyage à Cayenne, dans les deux Amériques et chez les anthropophages . . . contenant . . . des notions particulières sur Collot d'Herbois et Billand de Varennes, sur les îles Séchelles . . . , sur la religion, le commerce et les moeurs des sauvages, des noirs, des créoles et des quakers. Paris, the author. 2 vol. ns it: in Bibliothèque Nationale, Paris; listed in F.Engerand: Ange Pitou: Paris, Leroux, 1899

Second edition, 1807. ns it

PIXELL, Helen L.M.

1913 Polychaeta of the Indian Ocean, together with some species from the Cape Verde Islands. Trans.Linn.Soc.Lond.(Zool.), 16: 70-92, 2 pl. [In GARDINER, J.S. and others 1907-1936.] N §

PLANCHON, J.E.

1849 Le cocotier des Séchelles. Flore Serres, 5: 523-526, 1 pl. [Based on HOOKER, Sir W.J.] N

PLATE, L.

1908 Die Solenenconchen der 'Valdivia'-Expedition. Valdivia Rep., 9: 337-362, 1 pl. Z

PLAYFAIR, R.L.

1867 The fishes of Seychelles. Proc.zool.Soc.Lond., 846-872, 2 pl. LUZ

PLAYFAIR, R.L. and GUNTHER, A.C.L.G.

1866 The fishes of Zanzibar. London, Van Voorst. [Many Seychelles species described.] N

PLOMLEY, N.J.B.

1968 Numbers of flying fish observed during three voyages across the Indian Ocean. J.Zool., 155: 111-129. [Included Chagos.] Z

POCKLINGTON, R.

1965 A summary of birds seen over the western Indian Ocean, August-November 1963. Ibis, 107: 385-386. [From RV 'Atlantis II'.] N

Coll.Repr.Woods Hole oceanogr.Instn, no.1610. LUO

1966 See BAILEY.

1967 Observations by personnel of RV 'Atlantis II' on islands in the Indian Ocean. Sea Swallow, 19: 38-41. [Found introduced species of birds flourishing on Diego Garcia in 1965-1966, and native sea-bird colonies on the Egmont group, Chagos. Reported also on Amirantes, Farquhar and Seychelles.] Edward Grey Institute, Oxford §

POCOCK, R.I.

1893 Upon the identity of some of the types of Diplopoda contained in the collection of the British Museum, together with descriptions of some new species of exotic Iulidae. Ann. Mag.nat.Hist., ser.6, 11: 248-254. [Spirobolus urophorus and naressii from Mahé on 251-252, from the 'Alert' collection.] LUC

1904 Arachnida [of the Maldive and Laccadive Archipelagoes]. In GARDINER, J.S. and others 1901-1906, 2: 797-805, 1 pl. [Included Sason cinctipes, mentioned as occurring also in Seychelles.]

POISSON, H.

1953 Contribution à l'étude de la faune malacologique marine de l'archipel de Chagos et de l'île d'Agaléga: considérations générales sur la situation géographique des terres de cette portion de l'Océan indien. Bull.Acad.malgache, 31: 1954, 63-70, 2 pl. N

POLLARD, D.D.

1963 See SHOR.

POLLEN, F.P.L. and others.

1868-1877 Recherches sur la faune de Madagascar et de ses dépendances, d'après les découvertes de François P.L.Pollen et D.C. Van Dam. Leyden, Steenhoff and Brill. 5 vol., 1: in 5 pt. [Unfinished. Geographical distribution of Madagascar birds including Seychelles, by SCHLEGEL, H. and POLLEN, F.P.L., in 2: 156-163 and pl.; ditto fishes, by BLEEKER, P., in 4: 67-104 and pl.; ditto crustaceans, by HOFFMANN, C.K., in 5: 37-44; and ditto echinoderms, also by HOFFMANN, in 5: 53-56.] N [1: 2: 4: 5:]

POMEROY, M. Cleveland.

1969 Say it in Creole: Seychelles Islands, Indian Ocean. Victoria, Island Printers. [A booklet containing over one hundred tourist phrases in English and Creole.] C §

PONOMAREVA, L.A.

1964 See NAUMOV.

POOL, G.

1970 See PILLAY.

POORE, M.E.D.

1970a See STODDART, D.R. and POORE 1970a.

1970b See BAYNE et al. 1970a.

1970c See BAYNE et al. 1970b.

1970d See STODDART, D.R. and POORE 1970b.

1970e See STODDART, D.R. and POORE 1970c.

1970f See STODDART, D.R. and POORE 1970d.

POPOV, N.I., ORLOV, V.M., PATIN, S.A. and USAKOVA, N.P.
1964 Strontium-90 in the surface waters of the Indian Ocean in 1960-1961. Okeanologia, 4: 418-422. [In Russian. Results of RV 'Vityaz'.] NL
Also in IIOE Repr., 3: 1966, 578-582. [English title on viii.]

POTTS, F.A.
1908 Polychaeta of the Indian Ocean: I. The Amphinomidae. Trans. Linn.Soc.Lond.(Zool.), 12: 1909, 355-371, 2 pl. [In GARDINER, J.S. and others 1907-1936.] N §

1909 Polychaeta of the Indian Ocean: II. The Palmyridae, Aphroditidae, Polynoidae, Acoetidae and Signalionidae. Trans.Linn. Soc.Lond.(Zool.), 13: 1910, 325-353, 4 pl. [In GARDINER, J.S. and others 1907-1936.] N §

POTTS, G.W.
1969 Behaviour of the snapper Lutianus monostigma around Aldabra. Underwat.Ass.Rep., 4: 96-99. [Observation of a school thereof. With a summary.] N

1970 The schooling ethology of Lutianus monostigma (Pisces) in the shallow reef environment of Aldabra. J.Zool., 161: 223-235. LUZ

POTZTAL, Eva.
1962 See McCURRACH.

POULSEN, E.M.
1962 Ostracoda - Myodocopa: I. Cypridiniformes - Cypridinidae [of the 'Dana' expeditions]. Dana Rep., 10: no.57, 1-414. Z

POULTON, E.B.
1923 Mimicry in the butterflies of Fiji considered in relation to the Euploeine and Danaine invasions of Polynesia and to the female forms of Hypolimnas bolina L. in the Pacific. With an appendix on the numerical aspect of reciprocal mimicry (diaposematic resemblance) by TURNER, H.H. Trans.R.ent.Soc. Lond., 564-690, 25 pl. [Chagos form of H.bolina discussed on 643-645; Euploea mitra from Seychelles mentioned on 644.] LUZ

POUND, A.E.
1946 See PURCHASE.

POWELL, A.W.B.
1964 The family Turridae in the Indo-Pacific. Indo-Pacif. Mollusca, 1: no.5, 1964; no.7, 1967. N §

POWELL, L.
1908 Report on his mission to Diego Garcia and Peros Banhos. Port Louis. ns it: STODDART, D.R. 1971g

PRAIN, Sir D.
1890 A list of Laccadive plants. Scient.Mem.med.Offrs Army India, pt.5, 47-69. [Contained a table of distribution including Chagos.] N

PRAIN, Sir D. (ed.).
1906 Hooker's Icones plantarum: . . . , ser.4, 9: pt.1. London, Dulau, 1909. [Indokingia crassa (Araliaceae), tab.2805; Toxocarpus schimperianus (Asclepiadaceae), tab.2807; Neoschimpera heterophylla (Rubiaceae), tab.2810; Wielandia elegans (Euphorbiaceae), tab.2813; Geopanax procumbens (Araliaceae), tab.2821.] N

PRICE, J.H.
1969 The shallow sublittoral marine ecology of Aldabra. Phil. Trans.R.Soc., ser.B, 260: 1971, 123-171, 4 pl. [In WESTOLL and STODDART, D.R. (org.).] LUC §

PRIDHAM, C.
1846 The Mauritius and its dependencies. In: England's colonial empire: an historical, political and statistical account of the Empire, its colonies and dependencies, 1:. London, Smith Elder. [Especially pt.2, ch.5, which included all the islands in the region.] C

1849 An historical, political and statistical account of Mauritius and its dependencies. London, Boone. G

PRIOR, Sir J.
1812 Voyage in the Indian seas in the 'Nisus' frigate, to the Cape of Good Hope, Isles of Bourbon, France, and Seychelles; to Madras; and the isles of Java, St. Paul, and Amsterdam, during the years 1810 and 1811. ns it: FAUVEL, A.A. 1915
Also in: New voyages and travels . . . , 1:. London, Phillips, 1820. N
Beschreibung einer Reise in das indische Meer. Translated by C.F.Leidenfrost. Berlin, 1819. ns it: FAUVEL, A.A. 1915, 214

1819 Voyage along the eastern coasts of Africa, to Mosambique, Johanna and Quiloa . . . in the 'Nisus' frigate. London, Phillips. [Seychelles on 81-82.] B
Also in: Voyages and travels, 2:. London, Phillips. [Seychelles on 81-82.] N

PROCTER, J.

1971 Conservation in the Seychelles: report of the Conservation Adviser 1970. With a foreword by C.Chetty, Minister of Agriculture, Natural Resources and Marketing, Seychelles. Victoria, Government Printer. ns u §

PROSPERI, F.

1955 Gran Comora. Milan, Gargazanti. ns it nl: Catalogo cumulativo 1886-1957

Au royaume des coraux: de Zanzibar à la Grande-Comore. Translated by Annie Schalit. Paris, Julliard, 1956. NC §

Vanished continent: an Italian expedition to the Comoro Islands. Translated by D.Moore. London, Hutchinson, 1957. [Aldabra, Astove and Cosmoledo on 175-202.] G

PRUTER, A.T. and SHOMURA, R.

1966 International co-operation in the Indian Ocean. Nautilus, no.1, 7-8. [Dealt mainly with the nine cruises of RV 'Anton Bruun' in 1962-1964.] ns it

Also in IIOE Repr., 5: 1968, 827-830.

PRUVOT-FOL, A.

1942 Les gymnosomes: I [of the 'Dana' expeditions]. Dana Rep., 4: no.20, 1-54. Z

PUNNETT, R.C.

1907 On an arboricolous nemertean from the Seychelles. Trans. Linn.Soc.Lond.(Zool.), 12: 57-62, 1 pl. [In GARDINER, J.S. and others 1907-1936.] N §

PUNNETT, R.C. and COOPER, C.F.

1908 On some nemerteans from the eastern Indian Ocean. Trans.Linn. Soc.Lond.(Zool.), 13: 1909, 1-15, 2 pl. [In GARDINER, J.S. and others 1907-1936.] N §

PURCELL, F.

1931 See SEYCHELLES: GOVERNMENT.

PURCHASE, H.S. and POUND, A.E.

1946 East coast fever. Victoria, Government Printer. [A discussion broadcast on 30 June.] ns u §

PYRARD, F. [de LAVAL].

1611 Discours du voyage des François aux Indes orientales . . . . Paris, Le Clerc. [Shipwrecked on the Maldive Islands from 1602 to 1607; discussed the origin of coco-de-mer nuts washed ashore.] ns it: Gray (see below)

Second edition, largely rewritten, as: Voyages des français aux Indes orientales. Edited by Bignon and Bergeron. Paris, Dallin, 1615. 2 vol. [Gave the origin of coco-de-mer nuts as either from an island called "Poulloys" or from the bottom of the sea.] ns it: BLATTER 1910, FAUVEL, A.A. 1915

Third edition, 1619. ns it: Gray (see below)

Fourth edition as: Voyage de François Pyrard de Laval . . . . Edited by P.Du Val. Paris, 1679. 2 vol. [Origin of coco-de-mer nuts in 1: ch.1, 212.] ns it: YULE and BURNELL; FAUVEL, A.A. 1915

The voyage of François Pyrard of Laval to the East Indies, the Maldives, the Moluccas and Brazil. Translated from the third edition by A.Gray and H.C.P.Bell. London, Hakluyt Society, 1887-1890. 2 vol., 2: in 2 pt. [Coco-de-mer nuts, called "Tauarcarré", in 1: 230-232.] LUC

QUEAU-QUINCY, QUINCY, QUINSSY. See De QUINCY.

RAFFRAY, A.

1913 Coleoptera, Pselaphidae de l'Archipel des Seychelles. Trans. Linn.Soc.Lond.(Zool.), 16: 118-138, 1 pl. [In GARDINER, J.S. and others 1907-1936.] N §

RAGONOT, E.L.

1893 Sur une nouvelle phycite des îles Séchelles. Bull.Soc.ent.Fr., 294-295. Z

RAINSFORD, C.R.C.

1944 Government policy with regard to leprosy. Victoria, Medical Department. C

RAKESTRAW, N.

1965 See BIEN.

RAMAGE, C.S.

1962a The US meteorology program for the International Indian Ocean Expedition. Bull.Am.met.Soc., 43: 47-51. S

1962b The International Indian Ocean Expedition. USN Hydrographic Office pilot chart of North Atlantic Ocean, no.1400. Washington DC, US Navy. ns u

1963a The International Indian Ocean Expedition. Washington DC, US Department of Commerce: Weather Bureau. ns u

1963b Meteorology in scientific expedition. Bull.Am.met.Soc., 44: 1-3. S

1963c International Indian Ocean Expedition: meteorological research goes to sea. Mar.Obsr, 33: 74-78. S

1965 The summer atmospheric circulation over the Arabian Sea. J. atmos.Sci., 23: 1966, 144-150. [With an abstract.] NL §

Contribution no.128 of the Hawaii Institute of Geophysics. ns it

Also in IIOE Repr., 5: 1968, 660-666.

1968 Problems of a monsoon ocean. Weather, Lond., 23: 28-37. LUA
Contribution no.212 of the Hawaii Institute of Geophysics. ns it
Also in IIOE Repr., 6: 1969, 1194-1203.

RAND, A.L.
1936 The distribution and habits of Madagascar birds: a summary of the field notes of the Mission Zoologique Franco-Anglo-Américaine à Madagascar. Bull.Am.Mus.nat.Hist., 72: 1937, 143-499. [Included an argument for recognition of an avi-faunal region containing Madagascar and the Comoro, Mascarene, Seychelles and neighbouring groups.] LUZ

RAO, M.N.S. and RAO, M.Nagesa.
1945 Oil of patchouli. Bangalore, Government Printer. ns u §

RAO, M.Nagesa.
1945 See RAO, M.N.S.

RAO, S.T.S.
1961 On the pattern of surface circulation in the Indian Ocean as deduced from drift bottle recoveries. Indian J.Met.Geophys., 14: 1963, 1-4. [Confirmed the existence of a west wind drift and a south equatorial current.] LUA
Coll.Repr.Woods Hole oceanogr.Instn, no.1279. LUO

RASS, T.S.
1960 See BOGOROV.

RATHBUN, Mary J.
1894 Descriptions of two new species of crabs from the western Indian Ocean presented to the National Museum by Dr. W.L. Abbott. Proc.U.S.natn.Mus., 17: 1895, 21-24. [One from Aldabra and one from Seychelles.] LUZ

1911 Marine Brachyura [of the Sladen Expedition]. Trans.Linn.Soc. Lond.(Zool.), 14: 191-261, 6 pl. [In GARDINER, J.S. and others 1907-1936.] N §

RAULIN, V.
1912 Distribution of rain in Mauritius during the decade 1891-1900. Met.Mag.,Lond., 47: 5-7. [Seasonal and annual precipitation; included one station in Seychelles.] ns it: WALLACE, J.A., jr.

RAWLINS, R.
1956 The general in the garden. Blackwood's Mag., 280: no.1689, 1-10. [Discussion of Gordon's view that Praslin was the site of the Garden of Eden, with quotations from his manuscript.] NC §

RAY, J.

1685 Historia plantarum . . . . London, Faithorne. 3 vol. [Coco-de-mer nut on 2: 1359; its alleged medicinal properties were strongly doubted.] LUC

"R.E."

1878 See GUNTHER 1877.

READ, R.W.

1966 New chromosome counts in the Palmae. Principes, 10: 55-61. [Included Lodoicea and Phoenicophorium.] NL

RECLUS, J.J.E.

1889 Nouvelle géographie universelle, la terre et les hommes. Paris, Hachette. [Agalegas, Aldabra, Amirantes, Coetivy, Farquhar and Seychelles in 14: 135-141.] N

The universal geography: the earth and its inhabitants. Translated by E.G.Ravenstein and A.H.Keane. London, Virtue, 1878-1894. 19 vol. [Amirantes and Seychelles in 13: 471-474.] LUC

REDI, F.

1671 Esperienze intorno a diverse cose naturali . . . . Florence, Nave. [Tests on the coco-de-mer nut, described by Fauvel as "plus qu'enfantines", recounted in a letter to Father A. Chircher on 27-29.] ns it: FAUVEL, A.A. 1915

Also in: Opere di Francesco Redi, 2: 1-74. Venice, Hertz, 1742. [Coco-de-mer nut on 15-16.] N

Experimenta circa varias res naturales . . . . Amsterdam, Welstenium, 1685. [Contained in addition a drawing of the nut, showing the pedicel for the first time, on 30.] ns it: FAUVEL, A.A. 1915

REED, F.R.C.

1921 The geology of the British Empire. London, Arnold. [Especially ch.14, sect.3.] N

Second edition, 1949. [Especially ch.12, sect.3.] N §

REED, W.W.

[n.d.] The distribution of precipitation over the earth. Washington DC. [Monthly and annual precipitation for Seychelles over 29 years, on 165.] ns it: WALLACE, J.A., jr.

REES, W.J.

1950 The giant African snail. Proc.zool.Soc.Lond., 120: 577-598, 2 pl. [Appendix contained a note on the occurrence of Achatina fulica and A.panthera in Seychelles.] LUZ §

REGAN, C.T.

1907 Report on the marine fishes collected by Mr. J.Stanley Gardiner in the Indian Ocean. Trans.Linn.Soc.Lond.(Zool.), 12: 1908, 217-255, 10 pl. [In GARDINER, J.S. and others 1907-

1936.] N §

1912 New fishes from Aldabra and Assumption, collected by Mr. J.C.F. Fryer. Trans.Linn.Soc.Lond.(Zool.), 15: 301-302. [In GARDINER, J.S. and others 1907-1936.] N §

REGAN, C.T. and TREWAVAS, E.
1932 Deep-sea angler-fishes (Ceratioidea) [of the 'Dana' expeditions]. Dana Rep., 1: no.2, 1-113, 10 pl. Z

REGIMBART, M.
1895 Revision des Dytiscidae et Gyrinidae d'Afrique, Madagascar et îles voisines en contribution à la faune entomologique du Congo. Mém.Soc.r.ent.Belg, 4: 1-244. [Hydaticus leander Rossi from Seychelles on 198.] N

1897 Dytiscides nouveaux recueillis par M. Ch.Alluaud aux Séchelles et à l'île Maurice. Bull.Soc.ent.Fr., 208-210. N

1900 Coléoptères aquatiques capturés dans l'île d'Aldabra, près des Comores, par le Dr. Voeltzkow, de Strasbourg, et communiqués par le Dr. Bergroth. Bull.Soc.ent.Fr., 49-52. N

REICHENOW, A.
1900 Zwei neue Arten von der Tschakoinseln. Orn.Mber., 8: 140-141. [Birds from the 'Valdivia' expedition.] N

1904 Uebersicht der auf der Deutschen Tiefsee-Expedition gesammelten Vögel. Valdivia Rep., 7: 343-358, 2 pl. Z

REICHS-MARINE-AMT.
1909 Forschungsreise SMS 'Planet' 1906-1907. ["Planet Rep."] Berlin, Siegismund. 5 vol. [Passed between Chagos and Seychelles: 1: 50-52, map.] N

REILLY, T.A.
1964 See MATTHEWS, D.H.

REINBOLD, T.
1906 Die Meeresalgen der Deutschen Tiefsee-Expedition 1898-1899. Valdivia Rep., 2: pt.2, 1907, 549-586, 4 pl. Z

RENDAHL, H.
1939 Zur Herpetologie der Seychellen: I. Reptilien. Zool.Jb., Syst., 72: 255-328. S

RENSHAW, G.
1939 Some extinct birds: V. The pigeon hollandais. Bird Notes News, 18: 109-110, 1 pl. [The Seychelles species mentioned.] N

RENVOIZE, S.A.
1969 The origin and distribution of the flora of Aldabra. Phil. Trans.R.Soc., ser.B, 260: 1971, 227-236. [In WESTOLL and STODDART, D.R. (org.). Included all the islands in the Aldabra group. With an abstract.] LUC §

1970a See FOSBERG.

1970b See FOSBERG.

1970c See FOSBERG.

1970d See FOSBERG.

1970e See FOSBERG.

1970f See FOSBERG.

1970g See FOSBERG.

1971 Miscellaneous notes on the flora of Aldabra and neighbouring islands: I. Five new species of grasses. Kew Bull., 417-422. [Collected by the Royal Society Expedition in 1967-1968. Referred also to Amirantes, Farquhar and Seychelles.] LUB §

REVETT, W.
1609 approx. William Revett's account of the Seychelles. India Office records: marine journals, no.7. [The first recorded visit, so far as is known.] G
Also in JOURDAIN.

REYNE, A.
1938 On the food habits of the coconut crab (Birgus latro L.), with notes on its distribution. Archs néerl.Zool., 3: 283-320. [Doubted whether this crab could open undamaged coconuts, but accepted that it could climb trees and drink. Distribution in Agalegas, Assumption, Chagos and Seychelles discussed.] LUZ

RHO.
1885 Le isole Seychelles. Boll.Soc.afr.Ital., 4:. ns tt nl: BUCOP

RHYNE, C.F.
1971 Marine Algae of Diego Garcia. Atoll Res.Bull., no.149, 41-65. [In STODDART, D.R. and TAYLOR, J.D. (eds.).] NL §

RICHTERS, F.
1880 Decapoda. In MOBIUS, RICHTERS and Von MARTENS.

RIDGWAY, R.

1893 Descriptions of some new birds collected on the islands of Aldabra and Assumption, . . . by Dr. W.L.Abbott. Proc.U.S. natn.Mus., 16: 597-600. [Six species and one subspecies described, all new.] LUZ

1894a Note on Rougetius aldabranus. Auk, 11: 74. [From Assumption.] N

1894b Descriptions of some new birds from Aldabra, Assumption and Gloriosa Islands, collected by Dr. W.L.Abbott. Proc.U.S. natn.Mus., 17: 1895, 371-373. [Five new species from Aldabra and Assumption.] LUZ

1895 On birds collected by Dr. W.L.Abbott. Proc.U.S.natn.Mus., 18: 1896, 509-546. [Contained a tabulated list showing the distribution of 212 species, including those of the Mascarenes and Comoros.] LUZ

RIDLEY, M.W.

1956 Birds of a desert island. Ctry Life, Lond., 120: 1490-1492. [Desnoeufs, Amirantes.] N §

1957 Terns of the Seychelles Islands. J.Bombay nat.Hist.Soc., 54: 920-924, 2 pl. [Ten species described and illustrated.] LUTM §

1960 The land birds of the islands. Seychelles Annual, no.2, 32-35. T §

1961 Sea birds of the Seychelles. Seychelles Annual, no.3, 28-30. T §

1968 The sooty tern in Seychelles. J.Seychelles Soc., no.6, 11-16. K §

RIDLEY, M.W. and PERCY, R., Lord.

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1966 Report on the exploitation of sea bird eggs in Seychelles 1966. Victoria. Mimeographed. [Report of a second visit.] ns u §

RIDLEY, S.O.

1884a Alcyonaria [of the voyage of the 'Alert']. Alert Rep., 578-581. Z

1884b Spongida [of the voyage of the 'Alert']. Alert Rep., 582-630, 2 pl. Z

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1951 Sedimentation in the tropical Indian Ocean. Nature, Lond., 168: 737. [A letter to the editor describing work on Radiolaria from the 'Albatross' expedition.] LUC

1960 See WISEMAN.

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1967 See FUNNELL.

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1909 Handbook to the exhibits at the Imperial Institute. Victoria, Government Printer. [Contained a short general account of Seychelles and its products.] C §

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1968 Comment on the little green heron of the Chagos Archipelago. Ibis, 111: 1969, 101-102. [A report on three specimens of Butorides striatus javanicus collected by H.A.Fehlman on Diego Garcia in 1967.] P

1971 [Streptopelia picturata chuni (Reichenow) collected by Fehlmann and Payet on Diego Garcia in 1967.] Atoll Res.Bull., no.149, 197, footnote. [In BOURNE, W.R.P. 1971, which was in STODDART, D.R. and TAYLOR, J.D. (eds.). Suggested it as a valid endemic race.] NL §

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1968 Beneath the Indian Ocean. Geogrl Mag., 228-232. LUA

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1921 The volatile oil from the leaves of Ocimum gratissimum Linn. J.Soc.chem.Ind.,Lond.(Trans.), 40: 164T-165T. [Report on a sample.] LUC

ROBERTSON, R.
1968 See KOHN.

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1915 On the Cephalopoda obtained by the Percy Sladen Trust Expedition to the Indian Ocean in 1905. Trans.Linn.Soc.Lond. (Zool.), 17: 1921, 430-442, 2 pl. [In GARDINER, J.S. and others 1907-1936.] N §

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Also in IIOE Repr., 4: 1967, 627-642.

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1791 Voyage à Madagascar et aux Indes orientales. Paris, Pruault. [Seychelles on xliv-xlv; and a note on the coco-de-mer on 320-322.] N
A voyage to Madagascar and the East Indies. With a memoir on the Chinese trade by Brunel. [Translator not named.] London, Robinson, 1892. [Seychelles on li-lii; and a note on the coco-de-mer on 378-380.] G
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Another translation by J.Trapp. London, Jeffery, 1793. [Seychelles on xlvii-xlviii; and a note on the coco-de-mer on 333-335.]
See also FAUVEL, A.A. 1915.

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1865 Le cocotier des Seychelles: une merveille végétale. Flore Serres, 15: 168, 170-175. [Notes on the "bowl" of Lodoicea.] N §

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1932 The Indian Ocean. London, Harrap. G

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1892 See MAURITIUS: GOVERNMENT.

ROLFE, R.A.
1922 New orchids: decas XLIX. Kew Bull., 22-26. [Included three Seychelles species.] N

ROMANOV, J.A.
1961 Dynamic method as applied to the equatorial Indian Ocean. Okeanol.Issled., no.4, 25-30. [In Russian. Results of RV 'Vityaz'.] NL
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1968 Certain peculiarities of the tropospheric circulation in the equatorial part of the Indian Ocean. Okeanol.Issled., no.19, 163-176. [In Russian. From the 36th cruise of RV 'Vityaz'.] NL

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1879 Uebersicht der Literatur von Ost-Afrika und den ostafrikanischen Inseln. Deckens Reisen, 3: pt.3, i-iv, 1-43. [Especially Abt. 5.] Z

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1970b Principal features of reef coral ecology in shallow water environments of Mahé, Seychelles. Symp.zool.Soc.Lond., no.28, 1971, 163-183. [In STODDART, D.R. and YONGE (eds.). Used concepts from plant sociology. With a synopsis.] LUZ §

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1971 Annotated check list of the corals of the Chagos Archipelago (including the recent collection from Diego Garcia), with remarks on their distribution. Atoll Res.Bull., no.149, 67-88. [In STODDART, D.R. and TAYLOR, J.D. (eds.). Based on collections by G.C.Bourne (1885), J.S.Gardiner (1905) and J.D. Taylor (1967).] NL §

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1969 Reef coral from Aldabra: new mode of reproduction. Science, N.Y., 166: 119-121. [Asexual reproduction in Goniopora. With an abstract.] LUZ §

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1965 The family Tridacnidae in the Indo-Pacific. Indo-Pacif. Mollusca, 1: 347-396. N §

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1954-1961 The war at sea 1939-1945. London, HMSO. 3 vol., 3: in 2 pt. [Described the use of Diego Garcia and Seychelles as British naval fuelling bases on 2: 33.] LUC

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1955 Pelecypods from the Seychelles collected by Mr. W.V.Hasselberg. Acta boreal., no.8, 1-23. [Described sixty-one species of which forty were unrecorded.] LUZ

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1954 La zone séismique médiane Indo-Atlantique. Proc.R.Soc., ser. A, 222: 387-397. [Showed that the line of earthquake epicentres following the Mid-Atlantic and Mid-Indian Ocean Ridges were connected south of the Cape of Good Hope.] LUC

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1897 Further notes on gigantic land tortoises. Novit.zool., 4: 407-408, 1 pl. P

1906 A new species of giant tortoise. Novit.zool., 13: 753-754. [Testudo gouffei from Thérèse Island, Seychelles.] P

1907 Extinct birds . . . . London, Hutchinson. [Palaeornis wardi, E.Newton on 66.] N

1915 On the gigantic land tortoises of the Seychelles and Aldabra-Madagascar group with some notes on certain forms of the Mascarene group. Novit.zool., 22: 418-442, 44 pl. P

1928 Notes on gigantic land tortoises. Proc.zool.Soc.Lond., 658-660. LUZ

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1952 Catalogue of the birds of Mauritius. Bull.Maurit.Inst., 3: pt.3, 155-217. [Mentioned the Aldabra lesser frigate bird, Agalega ibis and Seychelles white-capped noddy.] N

ROUSSIN, A.
1868-1870 Album de la Réunion. St. Denis. 5 vol. [Lodoicea seychellarum, with photographs, in 5: 124-139, 3 pl., signed by "A.J."] ns it nl: in catalogue of Bibliothèque Nationale, Paris, 157: which gave the number of vol. as 4; also FAUVEL, A.A. 1915, 257, 275-277

ROUX, F.
1967 See BENSON.

ROUX-ESTEVE, R.
1958 See ARNOULT.

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1959 The economy of the Seychelles and its future development. ["Rowe Report".] Victoria, Government Printer. [Included recommendations.] C §

ROY, B.C.(ed.).
1964 International Geological Congress: report of the twenty-second session, India, 1964: Volume of abstracts; and Group discussions on the geological and geophysical results of the International Indian Ocean Expedition: abstracts of papers. New Delhi. N

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1882 Official guide to the North Gallery, Royal Gardens, Kew. London, HMSO. ns
Sixth edition, 1914. [Biographical notes on Marianne North on v-x; notes on 45 paintings of Seychelles plants by Miss North on 51 and 72-79; notes on 15 Seychelles woods, forming the panelled wainscot below the paintings, on 140-141.] N §

1951 The Royal Botanic Gardens, Kew: illustrated guide. London, HMSO. [Marianne North on 9.] K

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RUMPHIUS (RUMPF, G.E.).
1741-1755 Herbarium amboinense . . . . Amsterdam, Changuion. 7 vol. [In Latin and Dutch. Coco-de-mer nut ("cocus maldivicus") in 6: 1750, 210-217, tab.81, with description, mythology, drawing and discussion of its use; sceptical about alleged medicinal properties.] N

RUSSELL, E.S.
1909 See THOMSON.

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1965 Southern hemisphere beach rock. Geogrl Rev., 55: 17-45. [Seychelles on 40-45.] LUA §

RUSSELL, T.C.
1958 See GREAT BRITAIN: ADMIRALTY 1891.

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1864 Mauritius and Madagascar: journals of an eight years' residence in the diocese of Mauritius, and of a visit to Madagascar. London, Seeley Jackson and Halliday. [Visits to Chagos, Coetivy and Seychelles described.] C

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1963 International Indian Ocean Expedition. AIBS Bull., 13: no.5, 48-51. NL

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1966 Primary organic production in relation to the chemistry and hydrography of the western Indian Ocean. Limnol.Oceanogr. 11: 371-380. [With an abstract.] LUO
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Also in IIOE Repr., 5: 1968, 333-342.

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1964 Layers of increased salinity in the northern part of the Indian Ocean. Trudӯ Inst.Okeanol., 64: 51-58. [In Russian. Results of RV 'Vityaz'.] NL
Also in IIOE Repr., 1: 1965, 379-386. [With an untitled summary in English; English title on xiv.]

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1955 Island bibliographies: Micronesian botany; Land environment and ecology of coral atolls; Vegetation of tropical Pacific islands. Washington DC, National Academy of Sciences: National Research Council, Publ. no.335, 1-577. [Entries arranged alphabetically by author, with subject indexes. Sect.2 included Indian Ocean atolls. Supplemented by SACHET and FOSBERG 1971.] N §

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1919 Ausrüstung der 'Valdivia'. Valdivia Rep., 10: 1925, 207-339, 3 pl. Z

SACKOV, K.Z.
1964 See IVANENKOV.

SADLER, J.C.
1969 Average cloudiness in the tropics from satellite observations. Honolulu, East-West Center. ns u
Abstracted in IIOE Repr., 7: 1971, 1249-1251.

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1960 Revision of the genus Pandanus: V. Pandanus of the Maldive Islands and the Seychelles Islands, Indian Ocean. Pacif.Sci., 15: 1961, 328-346. [Four Seychelles species described and one Aldabra species mentioned.] N §

SAINT-HILAIRE, J.H.J.
1805 Exposition des familles naturelles, de la germination des plantes. Paris and Strasbourg, Treuttel. [Lodoicea "callipyge" in 1: 96.] N

SAINT VINCENT, J.B.G.M. Bory de, Baron. See BORY De SAINT VINCENT.

SALISBURY, Sir E.J.
1942 The reproductive capacity of plants: studies in quantitative biology. London, Bell. [Lodoicea fruits mentioned on 4.] LUB

SALOMONSEN, F.
1933 Notes on some Lemurian birds. Proc.zool.Soc.Lond., 1934, 219-224. [Described local varieties of three species of heron or egret from Aldabra, Assumption, Diego Garcia and Seychelles, as represented in the British Museum.] LUZ

SAMPSON, W.
1914 Coleoptera: Platypodidae and Ipidae from the Seychelles Islands. Trans.Linn.Soc.Lond.(Zool.), 16: 379-391. [In GARDINER, J.S. and others 1907-1936.] N §

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1967 Het atoll Aldabra, een Museum van Naturlijke Historie: door defensie-plan van Amerika en England bedrig Maandblad over tropisch en subtropisch. Gebeiden, 60: no.15, 11-14. ns u

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1910 Uber die Geschichte der Tierwelt von Ceylon. Zool.Jb.(Suppl.), 12: 1-160, 3 pl. Z

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1957 See CHIBA.

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1963 Geographic sketch of coastal plants of the granitic Seychelles. J.Seychelles Soc., no.3, 58-63. K §

1965 The Seychelles Archipelago and its palms. Bull.Mo.bot.Gdn, 53: no.9, 8-15. K §

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1886 On the birds collected by Mr. G.C.Bourne on the island of Diego Garcia, Chagos group. Proc.zool.Soc.Lond., 335-337. [Followed BOURNE, G.C. 1886b; fourteen species described.] LUZ

SAUSSURE. See De SAUSSURE.

SAUVAGE, A.
1948 See PETERS, A.J. 1948-1949.

SAUVAGE, E.
1875 La tortue éléphantine. Nature, Paris, no.129, 585-587. [Discussion of its distribution.] N

SAUZIER, T.
1892 Tortue de terre gigantesque. Nature, Paris, no.1016, 395-398. [Description of a specimen from Mauritius and discussion of its distribution.] N

1893 Les tortues de terre gigantesques des Mascareignes et de certaines autres îles de la mer des Indes. Paris, Masson. [Included Aldabra and Seychelles forms.] N §

1894a Contributions à l'histoire et à la géographie de l'archipel des Seychelles. Revue hist.litt.Ile Maurice, 1 and 16 March, 65-72, 81-92. ns tt nl: BUCOP

1894b Bibliographie des îles Seychelles. Revue hist.litt.Ile Maurice, no.7. ns tt nl: BUCOP

1895 Sur une gigantesque tortue terrestre, d'après un spécimen vivant des îles Egmont. C.r.hebd.Séanc.Acad.Sci., Paris, 121: 430-432. [Measurements of a giant tortoise brought to Paris from Chagos.] N

1899 Note sur l'origine de la tortue terrestre géante T.hololissa Günther. Bull.Soc.zool.Fr., 24: 138-142. LUZ

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1961 Coconut disease situation in Seychelles. In: Papers presented at the first meeting held in Trivandrum, India, of the FAO Technical Working Party on Coconut Production, Protection and Processing, 28-29. Bangkok, FAO. T §

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1902 Beiträge zur Kenntnis der auf den Seychellen lebenden Elefanten-Schildkröten. Valdivia Rep., 3: 101-129, 7 pl. Z

SCHAFFER, J.C.
1969 See COGAN.

Van SCHAUBURG, R. Snouckaert, Baron. See SNOUCKAERT van SCHAUBURG.

SCHAUFUSS, C.
1897 Beitrag zur Käferfauna Madagascars: III. Tijdschr.Ent., 40: 209-225. [Collected by C.Alluaud.] N

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1926 Amphipoda: III. Die Gammariden der Deutschen Tiefsee-Expedition. Valdivia Rep., 23: 193-243, 1 pl. Z

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1921 Coleoptera: Cleridae [of the Sladen Expedition]. Trans.Linn. Soc.Lond.(Zool.), 18: 1922, 325-329. [In GARDINER, J.S. and others 1907-1936. In German.] N §

SCHILDER, F.A. and SCHILDER, M.
1938 Prodrome of a monograph on living Cypraeidae. Proc.malac.Soc. Lond., 23: 119-231. [Recorded numerous species from the area, especially on 204-205 and 223-225.] University College of North Wales, Bangor

SCHILDER, M.
1938 See SCHILDER, F.A.

SCHILLING, C.
1935 Das Herz von Hypogeophis und seine Entwicklung. Morph.Jb., 76: 52-91. N

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1897 Zur Kenntnis der Flora der Aldabra-Inseln. Abh.senckenb. naturforsch.Ges., 21: 77-91. [In VOELTZKOW and others 1897-1905.] N

SCHLECHTER, R.
1915 Kritische Aufzählung der bisher von Madagaskar, den Maskarenen, Komoren und Seychellen bekanntgewordenen Orchidaceen. Beih. bot.Zbl., 33: 390-440. [Included a table of distribution.] N

SCHLEGEL, H.
1868-1877 See POLLEN.

SCHMAUS, H. and LEHNOFER, K.
1926 Copepoda: IV. Rhincalanus Dana 1852 der Deutschen Tiefsee-Expedition: Systematik und Verbreitung der Gattung. Valdivia Rep., 23: 1927, 335-400. Z

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1932-1962 The Carlsberg Foundation's oceanographical expedition round the world 1928-30 and previous 'Dana' expeditions. ["Dana Rep."] Copenhagen, Reitzels, and London, Oxford University Press, for Carlsberg Foundation. 10 vol., 57 no. Z

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1893 Histeridae des îles Séchelles. Bull.Soc.ent.Fr., 99-103. [Collected by C.Alluaud.] Z

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1908 Gnathia aldabrensis n.sp. ein neue Isopode aus dem indischen Ozean. Wiss.Ergebn.Reise Ostafr. 1903-5, 2: 193-196. [In VOELTZKOW and others 1906-1923.] N

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1902 Oceanographie und maritime Meteorologie im Aufträge des Reichs-Marine-Amtes. Valdivia Rep., 1: 1-403, 40 pl. Z

1933a Die järhrlichen Niederschlagsmengen auf dem Indischen und Stillen Ozean. Annln Hydrogr.Berl., 61: 1-12, 2 pl. [Monthly and annual rainfall.] LUTI

1933b Die Bewölkung über dem Indischen und Stillen Ozean. Annln Hydrogr.Berl., 61: 280-290, 2 pl. [Data mainly from research cruises and from observations by the Netherlands Meteorological Institute.] LUTI

1935 Geographie des Indischen und Stillen Ozeans. Hamburg, Boysen. [With coloured maps.] G

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1932 Gondwana land bridges. Bull.geol.Soc.Am., 43: 875-916, 1 pl. [Presented evidence for land bridges, including one linking Madagascar with India from precambrian to cretaceous times.] LUG

SCHULZE, F.E.
1903 Hexactinellida [of the German Deep-sea Expedition]. Valdivia Rep., 4: 1904, 1-266, 52 pl. Z

1905 Die Xenophyophoren, eine besondere Gruppe der Rhizopoden. Valdivia Rep., 11: 1-55, 8 pl. Z

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1965 Selected bibliography of studies on the Indian Ocean prior to the International Indian Ocean Expedition. IIOE Repr., 1: 913-915. [Mainly oceanographic.] N §

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1960-1969 International Indian Ocean Expedition: collected reprints. ["IIOE Repr."] Paris, UNESCO, 1965-1971. 7 vol. N, LUO §

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1871 Description of a new species of dove from the coral-reef of Aldabra. Proc.zool.Soc.Lond., 692-693, 1 pl. [Turtur aldabranus.] LUZ

1899 See SCLATER, W.L.

SCLATER, W.L.

1912 See SHELLEY.

SCLATER, W.L. and SCLATER, P.L.

1899 The geography of the mammals. London, Paul. [Malagasy sub-region discussed and shown in a map.] N

SCOTT, H.

1910 Eight months' entomological collecting in the Seychelles Islands, 1908-1909. Trans.Linn.Soc.Lond.(Zool.), 14: 21-39. [In GARDINER, J.S. and others 1907-1936. The second visit of the Sladen Expedition.] N §

1912 Coleoptera, Lamellicornia and Adephaga [of the Sladen Expedition]. Trans.Linn.Soc.Lond.(Zool.), 15: 215-262, 1 pl. [In GARDINER, J.S. and others 1907-1936.] N §

1913 Coleoptera: Hydrophilidae, Histeridae [of the Sladen Expedition]. Trans.Linn.Soc.Lond.(Zool.), 16: 193-235, 1 pl. [In GARDINER, J.S. and others 1907-1936.] N §

1914 Mallophaga, Aphaniptera and Diptera Pupipara [of the Sladen Expedition]. Trans.Linn.Soc.Lond.(Zool.), 17: 161-167. [In GARDINER, J.S. and others 1907-1936.] N §

1917a Corylophidae (Coleoptera) from the Seychelles and Rangoon. Ann.Mag.nat.Hist., ser.8, 19: 1-32, 5 pl. [Indian Ocean species collected by the Sladen Expedition.] LUC

1917b See GROUVELLE.

1921a A geographical summary based on Dr. Max Bernhauer's enumeration of the Staphylinidae of the Seychelles, Chagos and Aldabra Islands, with notes on their biology. Trans.Linn.Soc. Lond.(Zool.), 18: 1922, 187-193. [In GARDINER, J.S. and others 1907-1936.] N §

1921b Coleoptera: Scydmaenidae, Scaphidiidae, Phalacridae, Cucujidae (supplement), Lathridiidae, Mycetophagidae (including Propalticus), Bostrychidae, Lyctidae [of the Sladen Expedition]. Trans.Linn.Soc.Lond.(Zool.), 18: 1922, 195-260, 3 pl. [In GARDINER, J.S. and others 1907-1936.] N §

1922 See FLEUTIAUX.

1923 See BEZZI.

1924 Coleoptera: Ptinidae and Anobiidae of the Seychelles. Ann. Mag.nat.Hist., ser.9, 14: 345-426. [Collected by the Sladen Expedition.] LUC

1925a Zoo-geographical and systematic notes on the Nycteribiidae (Diptera Pupipara) of India, Ceylon and Burma. Rec.Indian Mus., 27: 351-384. [An Assumption species mentioned on 383.] N

1925b Coleoptera, Ciidae [of the Sladen Expedition]. Trans.Linn. Soc.Lond.(Zool.), 19: 1926, 1-41, 1 pl. [In GARDINER, J.S. and others 1907-1936.] N §

1926 Coleoptera from the Seychelles and adjacent islands: Carabidae (supplement), Cryptophagidae (supplement), Dermestidae, Lymexylonidae, Rhipiceridae, Sphindidae, Throscidae, Brenthidae. Ann.Mag.nat.Hist., ser.9, 18: 50-76. [Collected by the Sladen Expedition.] LUC

1927 See ESBEN-PETERSEN.

1931 See BERNHAUER.

1932a Note on insects associated with ants and termites in the Seychelles Islands. Entomologist's mon.Mag., 68: 169-172. [Ten species collected in the Sladen Expedition.] N

1932b General conclusions regarding the insect fauna of the Seychelles and adjacent islands. Trans.Linn.Soc.Lond.(Zool.), 19: 1933, 307-391, 7 pl. [In GARDINER, J.S. and others 1907-1936.] N §

SCOTT, H., DISTANT, W.L. and SHELFORD, R.

1912 A contribution to the knowledge of the fauna of Bromeliaceae. Ann.Mag.nat.Hist., ser.8, 10: 424-438, 1 pl. [Mainly about insects living in the axils of Bromeliaceae collected in

Seychelles.] LUC

SCOTT, Sir R.
1961 Limuria: the lesser dependencies of Mauritius. London, Oxford University Press. [Included Agalegas and the Chagos group; mainly historical and descriptive. Contained a bibliographical list of material, including much published in Port Louis.] NC §

SEARS, Mary.
1966 See DEACON.

SEDGWICK, A.
1905a The Indian Ocean expedition. Geogrl J., 26: 458. [A note referring to SEDGWICK 1905b.] Z

1905b Exploration of the Indian Ocean. With a letter from GARDINER, J.S. Nature, Lond., 72: 341-342. [The first visit of the Sladen Expedition in 1905, to the Amirantes, Chagos, Farquhar, Providence and Seychelles groups, Coetivy Island and the Saya de Malha Bank, as well as to the Cargados group.] Z

1905c The Percy Sladen Expedition in HMS 'Sealark'. With a letter from GARDINER, J.S. Nature, Lond., 73: 43-44. [The first visit in 1905.] Z

1905d The Percy Sladen Expedition in HMS 'Sealark' to the Indian Ocean. With a letter from GARDINER, J.S. Nature, Lond., 73: 184-186. [The first visit in 1905.] Z

SEEMAN, B.
1856 Popular history of the palms and their allies . . . . London, Reeve. [Lodoicea on 238-245, 1 pl.] N §

1870 Palms: IV. Gdnrs' Chron., 23 April, 561. [Included some Seychelles species.] N

SELYS-LONGCHAMPS. See De SELYS-LONGCHAMPS.

SENO, J.
1962 Plankton collected by the 'Umitaka Maru' in the Indian Ocean. Inf.Bull.Planktol.Japan, no.8, 12-14. [In Japanese.] LUM
Also in IIOE Repr., 2: 1966, 389-392. [With a titled abstract in English.]

1965 See OZAWA.

SEWELL, R.B.S.
1932 The coral coasts of India. Geogrl J., 79: 449-465. [With discussion.] Z

1934 The John Murray Expedition to the Arabian Sea. Nature, Lond., 133: 86-89, 669-672; 134: 685-688. Z

1935 The John Murray Expedition 1933-34; scientific reports: introduction and list of stations. Mabahiss Rep., 1: 1-41, 1 pl. N

1937 See WISEMAN.

1940 Copepoda: Harpacticoida [of the John Murray Expedition]. Mabahiss Rep., 7: 117-382, 1 pl. N

1947 The free-swimming planktonic Copepoda: systematic account. Mabahiss Rep., 8: 1-303. N

1948 The free-swimming planktonic Copepoda: geographical distribution. Mabahiss Rep., 8: 317-592, 2 pl. N

1949 The littoral and semi-parasitic Cyclopoida, the Monstrilloida and Notodelphyoida. Mabahiss Rep., 9: 17-199, 1 pl. N

1951 The epibionts and parasites of the planktonic Copepoda of the Arabian Sea. Mabahiss Rep., 9: 255-394. N

1953 The pelagic Tunicata [of the John Murray Expedition]. Mabahiss Rep., 10: 1-91, 1 pl. N

SEWELL, R.B.S. and others.

1935-1966 The John Murray Expedition 1933-34: scientific reports. ["Mabahiss Rep."] London, Trustees of the British Museum. 11 vol. N

SEYCHELLES: DEPARTMENT OF AGRICULTURE.

Annual Ann.Rep. . . . for the year . . . . Victoria, Government Printer. C [1951-] §

SEYCHELLES: DEPARTMENT OF EDUCATION.

Annual Short report . . . for the year . . . . Victoria, Government Printer. O [1960-, imperfect] §

Triennial Report . . . for the triennium . . . . Victoria, Government Printer. C [1951-] §

SEYCHELLES: DEPARTMENT OF EDUCATION (TINGAY, F.J.F.).

1964 General survey [of education] for the period 1961-64. Victoria, Government Printer. C §

SEYCHELLES: DEVELOPMENT PROGRAMME COMMITTEE.

1947 Seychelles ten-year development plan: report of the committee . . . . Victoria, Government Printer. [The first major plan following the Colonial Development and Welfare Acts; contained recommendations in all important sections of the Colony's development for 1947-1957. Chairman: F.D.Jakeway.] C §

[1955?] Review of the Seychelles ten year development plan. Victoria, Government Printer. [Recommended no major changes in the 1947-1957 plan.] C §

SEYCHELLES: GOVERNMENT.

[n.d.] Blue book for the Colony of Seychelles 1901-1914. Victoria, Government Printer. ns it: WALLACE, J.A., jr.

1956 Five-year development plan 1956-1960 . . . . Victoria, Government Printer. [The follow-on from the first plan.] C §

1959a Seychelles development plan. Victoria, Government Printer. [The impact of mainly COOKE, FAULKNER and ROWE at the end of the 1950s. Placed the main emphasis on the expansion of agriculture, tourism and overseas communications, but advocated also investigation of possible mineral, forest and oceanic resources and development of manufacturing and processing industries.] C §

1959b Statement of government policy in connection with the Rowe and Hurd Reports. Sess.Pap., no.1. Victoria, Government Printer. C §

[1959c] A plan for Seychelles. Victoria, Government Printer. [Covered the period 1957-1963, following COOKE, FAULKNER and ROWE.] C §

1963 1964-1966 development plan. Mimeographed. C §

1965 1966-1969 development plan. Victoria, Government Printer. C §

1969a Development plan for the period 1969-72: draft. Victoria, Government Printer. O §

[1969b] Tourism development in the Seychelles. Victoria, Government Printer. [A White Paper setting out government policy for encouraging expansion thereof.] C §

1971 Conservation policy in the Seychelles. Victoria, Government Printer. [A White Paper following PROCTER.] ns u §

SEYCHELLES: GOVERNMENT (BONNETARD, N.G.).

1921 Report and general abstract of the census of the Colony of Seychelles. Victoria, Government Printer. C §

SEYCHELLES: GOVERNMENT (BOULLE, V.).
1902 Report and general abstracts of the census of the Seychelles Islands of 1901. [Port Louis, Central Printing Establishment?] C §

SEYCHELLES: GOVERNMENT (MICHEL, E.).
1948 Colony of Seychelles: census report for the year 1947. Victoria, Government Printer. C §

SEYCHELLES: GOVERNMENT (PURCELL, F.).
1931 Colony of Seychelles: census for the year 1931. Victoria, Government Printer. [For the first time included Farquhar.] C §

SEYCHELLES: GOVERNMENT (TONNET, L.A.).
1912 Report and general abstracts of the census of the Seychelles Islands of 1911. [Victoria, Government Printer.] C §

SEYCHELLES: LABOUR AND WELFARE DEPARTMENT.
Annual Ann.Rep. . . . for the year . . . . Victoria, Government Printer. [There was a combined report for the years 1961 and 1962.] C [1954-1956, 1958-1965] §

Triennial Trienn.Rep. . . . for the years . . . . Victoria, Government Printer. O [1958-] §

SEYCHELLES: MEDICAL DEPARTMENT.
Annual Ann.Rep. Victoria, Government Printer. C [1951-1960, 1962-] §

SEYCHELLES: METEOROLOGICAL DEPARTMENT.
[n.d.] Meteorological observations, 1909-1949. [Excerpts from GREAT BRITAIN: COLONIAL OFFICE annual. Series 1940-1949 was issued as a sect. in EAST AFRICA HIGH COMMISSION: METEOROLOGICAL DEPARTMENT n.d.] ns it: WALLACE, J.A., jr.

SEYCHELLES: NATURAL RESOURCES COMMITTEE: 1963.
[1963?] Report . . . . Mimeographed. [Chairman: G.P.Lloyd.] C: in catalogue but missing

SEYCHELLES: NATURAL RESOURCES AND ECONOMIC DEVELOPMENT COMMITTEE: 1965.
[1965?] [Report.] Mimeographed. [Chairman: G.P.Lloyd. Contained recommendations.] C §

SEYCHELLES: SOCIAL SERVICES COMMITTEE.
1963 Report . . . for the development plan 1963-1966. Mimeographed. [Contained recommendations for the coming period.] C §

1965 Report. Mimeographed. Contained recommendations for 1966-1969. [Chairman: G.P.Lloyd.] C §

SHACKO, G.
1880 Anatomie einiger Landschnecken. In MOBIUS, RICHTERS and Von MARTENS. [Three species of land snail described.]

SHARPE, Pat.
1944 A Seychelles diary. Bombay, Thacker. ns u §

SHARPE, R.B.
1884 Birds [of the voyage of the 'Alert']. Alert Rep., 483-485. Z

SHEARME, F.N.
1934 See GREAT BRITAIN: ADMIRALTY 1891.

SHEFFIELD, Frances M.L.
1950 The clove trees of the Seychelles. E.Afr.agric.J., 16: 3-8. [Discussed the freedom of Seychelles clove trees from "sudden death" disease.] N §

SHEIFORD, R.
1912 See SCOTT, H.

SHELLEY, G.E.
1896-1912 The birds of Africa . . . . London, Porter. 5 vol. 5: pt.2, completed by SCLATER, W.L.; London, Sotheran, 1912. [Several Aldabra and Seychelles species described and illustrated, especially in 2:.] N

SHOMURA, R.
1966 See PRUTER.

SHOR, G.G., jr.
1965 See FRANCIS, T.J.G.

SHOR, G.G., jr. and POLLARD, D.D.
1963 Seismic investigations of Seychelles and Saya de Malha Banks, northwest Indian Ocean. Science, N.Y., 142: 48-49. [Work done in RV 'Argo' and 'Horizon' in 1962. Suggested that granite underlay the Seychelles Bank but not the Saya de Malha Bank.] LUC
Also in IIOE Repr., 1: 1965, 679-680.

SHUNTOV, V.P.
1967 Numerical record of sea birds in the eastern part of the Indian Ocean. Oceanology, 8: 1968, 394-401. [Work in RV 'Akademik Berg' and 'Seskar' in 1965, 1966 and 1967. With a summary and conclusions.] LUO

SICARD, A.
1912 Coleoptera, Coccinellidae [of the Sladen Expedition]. Trans. Linn.Soc.Lond.(Zool.), 15: 361-366. [In GARDINER, J.S. and others 1907-1936. In French.] N §

SIEBENROCK, F.

1902 Zur Systematik der Gattung Sternothaerus Bell. Zool.Anz., 26: 1903, 191-199. [S.sinuatus from La Digue on 193-194.] LUZ

1903 Schildkröten von Madagaskar und Aldabra gesammelt von Prof. Dr. A.Voeltzkow. Abh.senckenb.naturforsch.Ges., 27: 1905, 239-260, 3 pl. [In VOELTZKOW and others 1897-1905.] LUZ

1906 Schildkröten von Ostafrika und Madagaskar. Wiss.Ergebn.Reise Ostafr.1903-5, 2: 1-40, 5 pl. [In VOELTZKOW and others 1906-1923. Seychelles species on 39.] N

1909 Uber die Berechtigung der Selbständigkeit von Sternothaerus nigricans seychellensis Siebenr. Zool.Anz., 34: 359-362. LUZ

SILAS, E.G.

1962a See JONES, S.

1962b Aspects of the taxonomy and biology of the oriental bonito Sarda orientalis (Temminck and Sehlegel). Proc.Symp. scombroid Fishes, mar.biol.Ass.India, Mandapam Camp, ser.1, 283-308, 2 pl. N

SILBERRAD, R.E.M.

1969a Bee-keeping in the Seychelles. Br.Bee J., 97: 18-19. P §

1969b The remotest colonies. Br.Bee J., 97: 126-128. [Chagos: visited a beekeeper on Diego Garcia but saw no bees on Salomon or Peros Banhos.] P §

1969c Colour and colourful. Br.Bee J., 97: 200-201. [Discussion of problems of beekeeping in Seychelles.] P §

1969d Bee keeping. J.Seychelles Soc., no.7, 1971, 19-28. [A lecture to the Seychelles Society on 28 May.] K §

1970 Bee keeping in Seychelles. Victoria, Government Printer. ns u §

SIMMONDS, F.J.

1956 An investigation of the possibilities of biological control of Melittomma insulare Fairm. (Coleoptera, Lymexylonidae), a serious pest of coconut in the Seychelles. Bull.ent.Res., 47: 685-702, 1 pl. [Reported rather negative results.] LUTM §

SIMON, E.

1864 Histoire naturelle des araignées. Paris, Roret. 2 vol. ns it

Second edition: 1: 1892; 2: 1897. [Nesiergus insulanus in 2: 927-928.] N

1893 Mission scientifique de M. Ch.Alluaud aux îles Séchelles . . . : arachnides. Bull.Soc.zool.Fr., 18: 204-211. [Twenty-five species described.] LUZ

1897 Arachnides recueillis en 1895 par M. le Docteur A.Brauer (de l' Université de Marburg) aux îles Séchelles. Annls Soc.ent.Fr., 66: 370-388. N

1901a Etude sur les Heliophanus d'Afrique et de Madagascar. Annls Soc.ent.Fr., 70: 52-61. [One Seychelles species collected by C.Alluaud.] N

1901b Descriptions d'espèces nouvelles de la famille des Salticidae. Annls Soc.ent.Fr., 70: 66-76. [One Seychelles species collected by C.Alluaud.] N

SIMON, N.
1969 See FISHER, J.M.M.

SIMROTH, H.
1910 Lissopode Nacktschnecken von Madagaskar, den Comoren und Mauritius: unter Berücksichtigung verwandter Arten. Wiss. Ergebn.Reise Ostafr.1903-5, 2: 577-622, 2 pl. [In VOELTZKOW and others 1906-1923. Urocyclidae from Amirantes and Seychelles on 608.] N

1913 Uber die von Herrn Prof. Voeltzkow auf Madagaskar und in Ostafrika erbeuteten Vaginuliden, nebst verwandtem Material von ganz Afrika. Wiss.Ergebn.Reise Ostafr.1903-5, 3: 129-216, 5 pl. [In VOELTZKOW and others 1906-1923. Included Seychelles species.] N

SIMS, R.
1971 Earthworms of Diego Garcia. Atoll Res.Bull., no.149, 171. [In STODDART, D.R. and TAYLOR, J.D. (eds.).] NL §

SIMS, R.W.
1960 The identification of Malaysian species of swiftlets Collocalia. Ibis, 103a: 1961, 205-210. [Mentioned C. francica from Seychelles on 208.] P

SISKINA, O.B.
1964 See ZELEZNOVA.

SISKINA, O.B. and ZELEZNOVA, A.A.
1964 Chlorinity of interstitial water of the northern part of the Indian Ocean. Trudȳ Inst.Okeanol., 64: 144-153. [In Russian.] NL

Also in IIOE Repr., 1: 1965, 776-785. [With a brief untitled summary in English; English title on xvi.]

SJOGREN, B.

1971a Norwegians never reached Aldabra. Seychelles Bull., 5 January. [Described the failure of an attempt at colonization from Madagascar in 1879.] ns u §

1971b Spillror av en Kontinent. Stockholm, Norstedt. ns u §

SLIMMING, D. and JARRET, A.

1970 The cowries of Seychelles: a colour illustrated handbook. London, Phillips. [With fifteen colour plates by P.Jarvis, and a map.] N: in catalogue but missing §

SMITH, B.G.C.

1969 Variety trials with Amani cassava in the Seychelles. E.Afr. agric.For.J., 35: 1970, 319-320. [Results of experimental comparison of yield from six clones bred at Amani, Tanzania, and imported from Kenya, with that of two local varieties. With a summary.] LUA §

SMITH, C.B.

[1938] Report on the re-organisation of education in Seychelles, 1938. [Victoria, Government Printer.] C [Eastern Pamph., no.404]

SMITH, E.A.

1884 Mollusca [of the voyage of the 'Alert']. Alert Rep., 487-508, 1 pl. Z

SMITH, J.L.B.

1955a The fishes of the family Anthiidae in the western Indian Ocean. Ann.Mag.nat.Hist., ser.12, 8: 337-350. [Reported to be surprisingly absent from Seychelles waters.] LUZ §

1955b The fishes of the family Pomacanthidae in the western Indian Ocean. Ann.Mag.nat.Hist., ser.12, 8: 377-384. [Mainly from the Aldabra and Seychelles regions.] LUZ §

1955c The fishes of the family Carapidae in the western Indian Ocean. Ann.Mag.nat.Hist., ser.12, 8: 401-416, 2 pl. LUZ §

1955d A fantastic fruit. Veld Vlei, 1: 10-11, 24. [Lodoicea.] ns tt nl: BUCOP §

1955-1958 The fishes of Aldabra. Ann.Mag.nat.Hist., ser.12, 8: 1955, 304-312, 689-697, 886-896, 928-937; 9: 1956, 721-729, 817-829, 888-892; 10: 1957, 395-400, 833-842; ser.13, 1: 1958, 57-63. [Lists and descriptions of fishes collected.] LUZ §

1956a Two new plectorhynchid fishes from Ceylon with a note on Sciaena foetela Forskal, 1775. Ann.Mag.nat.Hist., ser.12, 9: 97-101. LUZ

1956b The genus Luzonichthys, Herre, 1936. Copeia, no.4, 251. [Included two species from Aldabra and Astove.] N §

1956c The parrot fishes of the family Callyodontidae of the western Indian Ocean. Ichthyol.Bull.Rhodes Univ., no.1, 1-23, 5 pl. N §

1956d Swordfish, marlin and sailfish in South and East Africa. Ichthyol.Bull.Rhodes Univ., no.2, 24-34, 2 pl. N §

1956e The fishes of the family Sphyraenidae in the western Indian Ocean. Ichthyol.Bull.Rhodes Univ., no.3, 35-46, 2 pl. N §

1956f Old fourlegs: the story of the coelacanth. London, Longmans. [Malania, caught off Anjouan, Comoros. The possibility of its occurrence in the Aldabra and Seychelles regions was discussed.] P

1957a Dasyatid rays new to South Africa. Ann.Mag.nat.Hist., ser. 12, 10: 429-431. One species recorded from Aldabra and Seychelles. LUZ

1957b Two rapid fatalities from stonefish stabs. Copeia, no.3, 249. N §

1957c The fishes of the family Scorpaenidae in the western Indian Ocean. Ichthyol.Bull.Rhodes Univ., no.4, 49-72, 4 pl; no.5, 73-88, 2 pl. N §

1957d List of the fishes of the family Labridae in the western Indian Ocean with new records and five new species. Ichthyol. Bull.Rhodes Univ., no.7, 99-114, 2 pl. N §

1957e The labrid fishes of the subgenus Julis Cuvier, 1814 (in Coris Lacepède, 1802) from South and East Africa. Ichthyol. Bull.Rhodes Univ., no.8, 117-120, 2 pl. N §

1958a The genus Limnichthys Waite, 1904 in African seas. Ann.Mag. nat.Hist., ser.13, 1: 247-249. [One Aldabra species recorded.] LUZ

1958b Sharks of the genus Pterolampiops Springer, 1951 with notes on isurid sharks. Ichthyol.Bull.Rhodes Univ., no.10, 131-134, 2 pl. N §

1958c The fishes of the family Elestridae in the western Indian Ocean. Ichthyol.Bull.Rhodes Univ., no.11, 137-163, 3 pl. N §

1958d Fishes of the families Tetrarajidae, Caracanthidae and Synanciidae from the western Indian Ocean with further notes on scorpaenid fishes. Ichthyol.Bull.Rhodes Univ., no.12, 165-184, 8 pl. N §

1959a Gobioid fishes of the families Gobiidae, Periophthalmidae, Trypauchenidae, Taenioididae and Kraemeriidae of the western Indian Ocean. Ichthyol.Bull.Rhodes Univ., no.13, 185-225, 5 pl. N §

1959b Fishes of the families Blenniidae and Salariidae of the western Indian Ocean. Ichthyol.Bull.Rhodes Univ., no.14, 229-252, 6 pl. N §

1959c Serioline fishes (yellowtails: amberjacks) from the western Indian Ocean. Ichthyol.Bull.Rhodes Univ., no.15, 255-261. N §

1959d The identity of Scarus gibbus Rüppell, 1828, and other parrotfishes of the family Callyodontidae from the Red Sea and the western Indian Ocean. Ichthyol.Bull.Rhodes Univ., no.16, 265-281, 5 pl. N §

1959e Fishes of the family Lethrinidae from the western Indian Ocean. Ichthyol.Bull.Rhodes Univ., no.17, 285-295, 6 pl. N §

1960 Coral fishes of the family Pomacentridae from the western Indian Ocean and the Red Sea. Ichthyol.Bull.Rhodes Univ., no. 19, 317-349, 8 pl. N §

1961a Fishes of the family Anthiidae from the western Indian Ocean and the Red Sea. Ichthyol.Bull.Rhodes Univ., no.21, 359-369, 2 pl. N §

1961b Fishes of the family Apogonidae of the western Indian Ocean and the Red Sea. Ichthyol.Bull.Rhodes Univ., no.22, 373-418, 7 pl. N §

1962a The moray eels of the western Indian Ocean and the Red Sea. Ichthyol.Bull.Rhodes Univ., no.23, 421-444, 10 pl. N §

1962b Sand-dwelling eels of the western Indian Ocean and the Red Sea. Ichthyol.Bull.Rhodes Univ., no.24, 447-466, 6 pl. N §

1962c Fishes of the family Gaterinidae of the western Indian Ocean and the Red Sea with a résumé of all known Indo-Pacific species. Ichthyol.Bull.Rhodes Univ., no.25, 469-502, 4 pl. N §

1962d The rare "furred-tongue" Uraspis uraspis (Günther) from South Africa, and other new records from there. Ichthyol.Bull. Rhodes Univ., no.26, 511, 2 pl. N §

1963a Fishes of the family Syngnathidae from the Red Sea and the western Indian Ocean. Ichthyol.Bull.Rhodes Univ., no.27, 515-543, 8 pl. N §

1963b Fishes of the families Draconettidae and Callionymidae from the Red Sea and the western Indian Ocean. Ichthyol.Bull. Rhodes Univ., no.28, 547-564, 4 pl. N §

1964 The clingfishes of the western Indian Ocean and the Red Sea. Ichthyol.Bull.Rhodes Univ., no.30, 581-597, 6 pl. N §

1965 More than he could chew. Fld Tide, 6: no.12, 8-9. [An account of a mantis prawn nearly killed by trying to eat an inflated toby fish at Mahé, seen by Major and Mrs. I.W. Beattie.] N §
Reprinted in SMITH, J.L.B. 1968, 59-60.

1968 High tide. Capetown, Books of Africa. [Sharks at Seychelles on 12; SMITH, J.L.B. 1965 reprinted in toto on 59-60; Anguilla bicolor recorded from Seychelles on 139.] N §

SMITH, J.L.B. and SMITH, Margaret M.
1963 The fishes of Seychelles. Grahamstown, Rhodes University: Department of Ichthyology. Z §

SMITH, M.
1935 The sea snakes (Hydrophiidae). Dana Rep., 2: no.8, 1-6. Z

SMITH, Margaret M.
1963 See SMITH, J.L.B.

SMITH, W.A.
1971 Crustacea: cirripedes from Diego Garcia. Atoll Res.Bull., no.149, 103. [In STODDART, D.R. and TAYLOR, J.D. (eds.).] NL §

SNELL, H.J. and TAMS, W.H.T.
1920 The natural history of the island of Rodrigues. Proc.Camb. phil.Soc., 19: 283-292. [Some termites and Hymenoptera from Amirantes, Chagos and Seychelles mentioned.] N

SNIDER, R.G.
1961a The International Indian Ocean Expedition, 1959-64. Discovery, Lond., 22: 114-117. [With a map of cruises completed and planned, 1959-1963 (very difficult to read).] LUC

1961b The Indian Ocean expedition: an international venture. Trans.Am.geophys.Un., 42: 289-294. S

1962 Development of the International Indian Ocean Expedition. ICSU Rev., 4: 134-144. N

SNOPKOV, V.G.

1964 Some results of meteorological and upper air observations in the Indian Ocean during the winter monsoon. Trudy Inst. Okeanol., 64: 11-21. [In Russian. Results of RV 'Vityaz'.] NL

Also in IIOE Repr., 1: 1965, 339-349. [With a brief untitled summary in English; English title on xiv.]

SNOUCKAERT van SCHAUBURG, R., Baron.

1935 Les pigeons du genre Alectroenas. Alauda, 7: 328-335. [Included A.sganzini minor from Aldabra and A.pulcherrima from Seychelles.] N §

Van SOMEREN, E.C.C.

1947 The description of a new mosquito from the Seychelles. E.Afr. med.J., 24: 29-35. [Culex (Neoculex) stellatus.] LUTM

SOMERVILLE, B.T.

1909 See GARDINER, J.S.

SONNERAT, P.

1776 Voyage à la Nouvelle Guinée . . . . Paris, Ruault. [Seychelles in ch.1; coco-de-mer palm on 1-4 and 7 pl.; FAUVEL, A.A. 1915, 223, thought that the section on the coco-de-mer palm might have been read at l'Académie des Sciences on 13 December 1773.] Z

SOOT-RYEN, T.

1955 See ROST.

SORLIN, A.

1956 Oar i monsunen, resa till Seychellerne. Stockholm, Natur och Kultur. [Seychelles flora on 89-172, 14 pl. and a map.] ns u §

1957 Om vegetationen på Seychellerna. Svensk bot.Tidskr., 51: 135-158. [Mahé and Praslin, Seychelles. With a summary in English.] LUB §

SORNAY. See De SORNAY.

SOUTHWARD, A.J.

1967 On the ecology and cirral behaviour of a new barnacle from the Red Sea and Indian Ocean. J.Zool., 153: 437-444. [Tetrachthamalus oblitteratus.] LUZ

SPARCK, R.
1956-1964 See BRUUN.

SPARCK, R. (ed.).
1956 See BRUUN.

SPITZ, A.J.W.
1960 Health and morbidity survey, Seychelles, 1956-57. Bull.Wld. Hlth Org., 22: 439-467. [Presented findings on health and morbidity and relevant demographic factors.] LUTM §

SPRAGUE, T.A. and GREEN, M.L.
1933 Northea hornei or N.seychellana. Kew Bull., 206-207. [Discussion of species nomenclature.] N §

SPURS, T.J.
1890 Report on Aldabra. In GREAT BRITAIN: COLONIAL OFFICE 1889-1890, 46-50.

SQUIBBS, F.L.
1934 Report on Derris roots from Seychelles. [Source not stated. Contained correspondence with Imperial Institute.] C [Eastern Pamph. no.367]

STANNUS, H.S.
1941 Albinism. Br.med.J., 1: 608. [A letter adding to CHRISTIANSON 1941.] LUC

STEBBING, T.R.R.
1909 Isopoda from the Indian Ocean and British East Africa. Trans. Linn.Soc.Lond.(Zool.), 14: 1910, 83-122, 7 pl. [In GARDINER, J.S. and others 1907-1936.] N §

STECHOW, E.
1922 Hydroiden der Deutschen Tiefsee-Expedition. Valdivia Rep., 17: 1925, 383-546. Z

Van STEENIS, C.G.G.J.
1962 The land-bridge theory in botany, with particular reference to tropical plants. Blumea, 11: 235-372. [Especially 343.] N

STEIN, P.
1910 Diptera, Anthomyiidae, mit den Gattungen Rhinia und Idiella. Trans.Linn.Soc.Lond.(Zool.), 14: 149-163. [In GARDINER, J.S. and others 1907-1936.] N §

STEJNEGER, L.
1893 On some collections of reptiles and batrachians from East Africa and the adjacent islands, recently received from Dr. W.L.Abbott and Mr. William Astor Chanler, with descriptions of new species. Proc.U.S.natn.Mus., 16: 711-741. [Included N.Pike's collection from Seychelles. Fifteen Seychelles and

three Aldabra species described.] LUZ

STEUER, A.

1904 Copepoda der 'Valdivia'-Expedition. Zool.Anz., 27: 593-598. LUZ

1905 Einiges über die Copepoden der 'Valdivia'-Expedition. Verh. Ges.dt.Naturf.Arzte, 77: 1906, 204-205. [A short note on the distribution of some copepods.] N

1926 Copepoda: III. Cephalophanes G.O. Sars 1907 der Deutschen Tiefsee-Expedition: Systematik und Verbreitung der Gattung. Valdivia Rep., 23: 179-191. Z

1932 Copepoda: VI. Pleuromamma Giesbr. 1898 der Deutschen Tiefsee-Expedition. Valdivia Rep., 24: 1-119, 25 pl. Z

1933 Bericht über die Bearbeitung der Copepodengattung Pleuromamma Giesbr. 1898 der Deutschen Tiefsee-Expedition 'Valdivia'. Thalassia, 1: no.2, 1-48, 17 pl. N

STEWART, H.C.

1881 Agricultural resources of Seychelles. With comments by HORNE, J. Minutes Council Mauritius, no.116. C [Bot.Pamph., no.1]

STIASNY, G.

1937 Scyphomedusae [of the John Murray Expedition]. Mabahiss Rep., 4: 203-242, 2 pl. N

1940 Die Scyphomedusen [of the 'Dana' expeditions]. Dana Rep., 4: no.18, 1-29, 2 pl. Z

STIRLING, W.

1843 Narrative of the wreck of the ship 'Tiger', of Liverpool (Captain Edward Searight), on the desert island of Astova, on the morning of the 12th of August, 1836; with some particulars respecting the ship, the residence of the crew on the island, and their subsequent deliverance; by Major (late Captain) W. Stirling. (Printed for circulation among his friends). Exeter, the author. [Pp. 1-154 plus 69 unnumbered pp. of letters plus 4 pp. of "Extracts from 'Musings in Egypt and other countries' by Major William Stirling" plus 1 frontispiece map of Astove, hand drawn, with place names in very faded ink. Contained notes on the natural history of Astove.] B [mis-titled and wrongly paginated] [Item largely by D.R.Stoddart]

Abridged in Blue Peter, 2: 1931, 74-83, 150-157, 206-209, 261-265. [With a different map.] ns it: in catalogue of Bodleian Library, Oxford §

STOCKDALE, F.A.

1931 Report on a visit to South and East Africa, Seychelles, the Sudan, Egypt and Cyprus, 1930-31. London, Colonial Office. [Contained recommendations on agriculture and the essential-oils industry in Seychelles, which included employing an entomologist to attempt the biological control of coccids infesting coconut trees.] C

Seychelles part republished separately as: Report on the Colony of Seychelles. Victoria, Government Printer. C §

STOCKS, T.

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1968c Threat to Aldabra. Geogrl Mag., 40: 800-808. [The British Government's military plan.] P

1968d Catastrophic human interference with coral island ecosystems. Geography, 53: 25-40. G §

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1969a Ecology and morphology of recent coral reefs. Biol.Rev., 44: 433-498. [A general account, with references to Indian Ocean reefs and atolls.] LUZ

1969b Retrospect and prospect of Aldabra research. Nature, Lond., 221: 1004-1006. LUP

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1971e Terrestrial fauna of Diego Garcia and other Chagos atolls. Atoll Res.Bull., no.149, 163-170. [In STODDART, D.R. and TAYLOR, J.D. (eds.).] NL §

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1971h Coral reefs and islands and catastrophic storms. In: Applied coastal geomorphology, edited by J.A.Steers, ch.9. London, Macmillan. [Chagos mentioned on 155.] LUG

1971i Rainfall on Indian Ocean coral islands. Atoll Res.Bull., no.147, 1-7. NL

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1967 Ecology of Aldabra Atoll, Indian Ocean. Atoll Res.Bull., no. 118, 1-141, 21 pl. N §

1970 Coral islands of the western Indian Ocean. Atoll Res.Bull., no.136, viii plus 224, 27 pl. [Based on visits by Royal Society personnel to Aldabra, Amirantes and Farquhar groups in 1967 and 1968. Contained also material on Agalegas as well as Cargados, Europa and Tromelin. Included lists and reviews of all previous visits and studies.] NL §

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1970b Geography and ecology of Desroches. Atoll Res.Bull., no.136, 155-165, 4 pl. [In STODDART, D.R. (ed.) 1970.] NL §

1970c Geography and ecology of Rémire. Atoll Res.Bull., no.136, 171-181. [In STODDART, D.R. (ed.) 1970.] NL §

1970d Geography and ecology of African Banks. Atoll Res.Bull., no. 136, 187-191. [In STODDART, D.R. (ed.) 1970.] NL §

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1870 On the probable existence of an ancient southern continent. Q.Jl geol.Soc.Lond., 27: 1871, 546-548. G

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1937 Phyllirhoidae [of the John Murray Expedition]. Mabahiss Rep., 5: 1-14. N

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1945 Report . . . on a visit to Seychelles, August-September 1944. Victoria, Government Printer. [Contained recommendations on agriculture.] C §

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1885 Das Antlitz der Erde. Index by L.Waagen. Prague and Vienna, Tempsky; Leipzig, Freytag; 1885-1909. 4 vol.; 3: in 2 pt. G

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The face of the earth. Translated by Hertha B.C.Sollas. Oxford, Clarendon, 1904-1924. 5 vol. [Land bridge discussed in 1: 417-420; coral-reef problem in 2: 505-510.] G

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1965 See BIEN.

SUHANOVA, I.N.

1961 See VINOGRADOV.

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1960 Forestry in the Seychelles: report of a visit by the Forestry Adviser in 1959. Victoria, Government Printer. [Contained nine pages of recommendations, mainly for supplying domestic needs, following SEYCHELLES: GOVERNMENT 1959a.] C §

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1963 See KNAUSS.

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1956 See HIRANO.

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1921 See JOICEY.

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1962 Gravity measurements on HMS 'Acheron' in South Atlantic and Indian Oceans. Bull.geol.Soc.Am., 73: 1171-1181. LUG

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1920 See SNELL.

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1934 The ridge in the Indian Ocean between Chagos Is. and Socotra. Nature, Lond., 134: 536. [A letter to the editor suggesting the name of "Carlsberg" ridge. See also PETTERSSON 1934a and 1934b. This is the name which has stuck.] LUC

TANNER, T.J.
1971 Seychelles' contribution to world meteorology. Sevchelles Bull., no.259, 2. ns u §

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1960 Les fougères des Mascareignes et des Seychelles. Phanérogamie, 16: 151-201. [A revision of the whole group.] K §

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1911 On the Mysidacea and Euphausiacea collected in the Indian Ocean during 1905. Trans.Linn.Soc.Lond.(Zool.), 15: 1912, 119-135, 2 pl. [In GARDINER, J.S. and others 1907-1936.] N §

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1968 The caecilians of the world: a taxonomic review. Lawrence, Ka., Kansas University Press. [Seychelles forms discussed on 36.] N

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1963 A preliminary account of the ecology of the reefs of Mahé. J.Seychelles Soc., no.3, 23-27. K §

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1967 Coral reef and associated invertebrate communities (mainly molluscan) around Mahé, Seychelles. Phil.Trans.R.Soc., ser. B, 254: 1968, 129-206, 7 pl. [With a distribution table of species.] LUC §

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1971c Crustacea: Brachyura and Anomura from Diego Garcia. Atoll Res.Bull., no.149, 93-101. [In STODDART, D.R. and TAYLOR, J.D. (eds.).] NL §

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1970 The flora, fauna and sediments of the marine grass beds of Mahé, Seychelles. J.nat.Hist., 4: 199-220. [With a summary.] LUZ

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1963 International Indian Ocean Expedition: brief report. Oceanus, 10: 1964, 26-27. LUO

1964 The Indian Ocean "bubble". Oceanus, 10: 14-15. [A short account of the genesis of the International Indian Ocean Expedition.] LUO

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1957 Sur quelques nouvelles observations hydrologiques relatives à la région équatoriale de l'Océan indien. Bull.Inf.Com.cent. Océanogr.Etude Côtes, 10: 115-143. LUO

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1910 Pteropoda and Heteropoda [of the Sladen Expedition]. Trans. Linn.Soc.Lond.(Zool.), 14: 165-189, 3 pl. [In GARDINER, J.S. and others 1907-1936.] N §

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1949b The Gymnosomata: II [of the 'Dana' expeditions]. Dana Rep., 6: no.36, 1-55. Z

TESSIER, Abbé.
1779 Mémoire sur l'importation du géroflier des Moluques aux isles de France, de Bourbon & de Séchelles, et de ces isles à Cayenne. In: Observations sur la physique, sur l'histoire naturelle et sur les arts . . . , 14: 47-54. N

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1964a See HEEZEN.

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THEOBALD, F.V.
1901-1910 A monograph of the Culicidae or mosquitoes . . . at the British Museum . . . . London, Trustees of the British Museum. 5 vol. [Contained the first records of mosquitoes in Seychelles, collected at Victoria by R.Denman, in 3: 1903: Culex fatigans on 225, Stegomyia fasciata on 141, S.scutellaris on 144.] LUZ

1911 Diptera, Culicidae [of the Sladen Expedition]. Trans.Linn. Soc.Lond.(Zool.), 15: 1912, 81-94, 1 pl. [In GARDINER, J.S. and others 1907-1936.] N §

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1897 Descriptions d'un cérambycide nouveau des îles Seychelles. Bull.Soc.ent.Fr., 66-67. N

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1900 Verzeichnis der von Herrn Dr. A.Voeltzkow gesammelten marinen und litoralen Mollusken. Abh.senckenb.naturforsch.Ges., 26: 241-252. [In VOELTZKOW and others 1897-1905. Aldabra species listed and some described.] LUZ

1902 Proneomenia valdiviae n.sp. Valdivia Rep., 3: 167-174, 1 pl. Z

1903 See Von MARTENS.

1918 Gastropoda der Deutschen Tiefsee-Expedition: II. Valdivia Rep., 17: 1925, 35-382, 34 pl. Z

THIELE, J. and JAECKEL, S.

1930 Muscheln der Deutschen Tiefsee-Expedition. Valdivia Rep., 21: 1931, 159-268, 10 pl. [Recorded seven species of mussel from Chagos.] LUO

THISELTON-DYER, Sir W.T.

1878 On the Dipterocarpeae of New Guinea, with remarks on some other species. J.Bot.,Lond., 16: 98-103. [First description of Vateria seychellarum on 103.] N

1910 Germination of the double coconut. Ann.Bot., 24: 224-230, 2 pl. [Lodoicea.] LUB

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1845 Enquiry into the nature and course of storms in the Indian Ocean south of the equator (with a view to discovering their origin, extent, rotary character, rate and direction of progression). London. S: in catalogue but missing

THOMAS, A.

1968 Forgotten Eden: a view of the Seychelles Islands in the Indian Ocean. London, Longman. [A popularly written account.] O §

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1908 Bibliographie des Seychelles. Victoria, Government Printer. [Supplement to the bibliography by FAUVEL, A.A. 1909; further supplemented by THOMASSET 1909.] C §

Also in FAUVEL, A.A. 1909.

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1957 The diurnal variation of precipitation in British East Africa. Tech.Memo.E.Afr.met.Dep., no.8, 1-70. [Included records from Mahé. Supplemented by THOMPSON, B.W. 1965.] M

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1965 Tables showing the diurnal variation of precipitation in East Africa and Seychelles. Tech.Memo.E.Afr.met.Dep., no.10, 1-49. [Supplement to THOMPSON, B.W. 1957.] M

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1950 Only the sun remembers. London, Dakers. [Autobiographical narrative by a Royal Marine who visited Chagos and Seychelles during the second world war.] Northumberland County Library, Morpeth

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1937 Hydrographical observations made during the 'Dana'-expedition 1928-30. Dana Rep., 1: no.12, 1-46. Z

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1909 Alcyonarians collected on the Percy Sladen Trust Expedition by Mr. J.Stanley Gardiner, M.A., FRS. Trans.Linn.Soc.Lond.(Zool.), 13: 1910, 139-211, 9 pl. [In GARDINER, J.S. and others 1907-1936.] N §

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1970 See FORSTER.

THORE, S.

1949 Investigations on the 'Dana': Octopoda: I. Bolitaenidae, Amphitretidae, Vitreledonellidae and Alloposidae. Dana Rep., 6: no.33, 1-85. Z

THORNELY, Laura R.

1911 The marine Polyzoa of the Indian Ocean from HMS 'Sealark'. Trans.Linn.Soc.Lond.(Zool.), 15: 1912, 137-157, 1 pl. [In GARDINER, J.S. and others 1907-1936.] N §

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1958 Looking forward. Victoria, Government Printer. [Four addresses broadcast by the Governor of Seychelles on the economic development of the Colony.] C §

THORPE, W.
1967 Aldabra and the vandals : the scientists' case. New Scient., 36: 471-472. [About the British-US defence plan.] LUC

THUNBERG, C.P.
1788-1793 Voyages . . . au Japon . . . . Translated by L.Langlès; natural history sections edited by J.B.Lamarck. Paris, Dendré, Garnery and Obré, 1796. 2 vol. [Admired a young coco-de-mer palm growing in the garden of the Governor of Ceylon in 1777 on 2: 414.] N

Travels in Europe, Africa and Asia, made between the years 1770 and 1779. London [?], 1799. 4 vol. [Alleged medicinal properties of coco-de-mer nuts, called in Colombo "Zee Calappers", on 4: 209.] ns it: YULE and BURNELL, 231

TIMONIN, A.G.
1971 The structure of plankton communities of the Indian Ocean. Mar.Biol., 9: 282-289. [Results of studies of species diversity and trophic structure in collections by RV 'Vityaz in 1960. With an abstract and a summary.] LUM

TINGAY, F.J.F.
1964 See SEYCHELLES: DEPARTMENT OF EDUCATION.

TIRMIZI, Nasima M.
1959 Crustacea: Peneidae: II. Series Benthesicymae [of the John Murray Expedition]. Mabahiss Rep., 10: 319-383. N

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1966 Octocoralliaires de Madagascar et des îles avoisinantes. Faune Madagascar, 21: 1-456. N

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TOKIOKA, T.
1962 The outline of the investigations made on chaetognaths of the Indian Ocean. Inf.Bull.Planktol.Japan, no.8, 5-11. [In Japanese.] LUM

Also in IIOE Repr., 2: 1966, 379-387. [With a titled abstract in English.]

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1967 See BE.

TOMLINSON, P.B.

1960 Essays on the morphology of palms: I. Germination and the seedling. Principes, 4: 56-61. [Growth of cotyledon of Lodoicea mentioned on 57.] NL §

TONNET, L.A.

1912 See SEYCHELLES: GOVERNMENT.

TOOMS, J.S.

1967 See CRONAN.

1968 See CRONAN.

TOPSENT, E.

1893 Mission scientifique de M. Ch.Alluaud aux îles Séchelles: spongiaires. Bull.Soc.zool.Fr., 18: 172-175. [Nine species described.] LUZ

TORNQUIST, A.

1904 Uber eine eocäne Fauna der Westküste von Madagaskar. Abh. senckenb.naturforsch.Ges., 27: 1905, 321-338, 1 pl. [In VOELTZKOW and others 1897-1905. Included Aldabran fossils.] LUZ

TOULGOET. See De TOULGOET.

TOUSSAINT, A.

1951 Select bibliography of Mauritius. Société de l'Histoire de l'Ile Maurice, Publ. no.4. Port Louis, Standard Printing Establishment. [Dependencies included.] C

1961 Histoire de l'Océan indien. Paris, Presses Universitaires. G §

History of the Indian Ocean. Translated by June Guicharnaud. London, Routledge and Paul, 1965; Chicago, University of Chicago Press, 1966. P §

1965 Le traffic commercial des Seychelles de 1773 à 1810. J. Seychelles Soc., no.4, 20-61. K §

Reprinted as Annexe 3 (458-485) in TOUSSAINT 1967.

1966 Shipbuilding in Seychelles. J.Seychelles Soc., no.5, 29-40. K §

1967 La route des îles: contribution à l'histoire maritime des Mascareignes. Paris, SEVPEN. [Included much Indian Ocean material. The long introductory ch. was given in an English as well as French version (87-163). Annexe 3 was a reprint of TOUSSAINT 1965.] University of Hull §

1968 Franconésie. Afr.contemp., no.40, 7-8. [Suggested this regional name for the Chagos, Mascarene and Seychelles island groups, largely on historical grounds.] NL §

1969 Early printing in Mauritius, Réunion, Madagascar and the Seychelles. Amsterdam, Vangendt; London, Paul; New York, Schram. In a series: The spread of printing, edited by C.Clair. [Seychelles on 44-46.] LUC

1971 L'atoll de Diego Garcia. Afr.contemp., no.55, 9-11. [A short geographical and historical account.] NL §

TOUSSAINT, A. and ADOLPHE, H.

1956 Bibliography of Mauritius (1502-1954), covering the printed record, manuscripts, archivalia and cartographic material. Port Louis, Esclapon. [Included Agalegas and Chagos; excluded Seychelles but contained references to it. The scientific material was not separated and is difficult to find.] N §

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1971 List of Diego Garcia Bryophyta. Atoll Res.Bull., no.149, 161-162. [In STODDART, D.R. and TAYLOR, J.D. (eds.).] NL §

TOWNSEND, C.H.

1931 Where the nineteenth century whaler made his catch. Bull.N.Y. zool.Soc., 34: 173-179, 1 pl. [Contained a world map with sperm whaling grounds plotted for 1821-1899.] N

1935 The distribution of certain whales as shown by the logbook records of American whaleships. Zoologica, N.Y., 19: 1-50, 4 pl. [Recorded the taking of sperm whales in the Indian Ocean between latitudes 18°N. and 40°S. in 1761-1920, on 15 and pl.1. Pl.1-4 were beautiful coloured maps with catches plotted.] LUZ

TRANTER, D.J.

1964 The International Indian Ocean Expedition. Aust.nat.Hist., 14: 323-325. NL §

Also in IIOE Repr., 5: 1968, 823-825.

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1959 Beyond the reefs. London, Allen and Unwin; New York, Dutton. [Collecting mother-of-pearl snails, hunting turtles etc.; photographs and maps of Aldabra, Astove, Cosmoledo, Farquhar and Seychelles; also visited Alphonse.] N §

Oltre la scogliera. Milan, Rizzoli. ns

1960 Underwater exploration. Seychelles Annual, no.2, 20-23. T §

1961 Shark for sale. London, Allen and Unwin. An account of the shark fishermen of Seychelles. P §
Pesciani da vendere. Milan, Rizzoli, 1964. ns
Requins à vendre. Translated by Hélène Seyrès. Paris, Flammarion, 1965. ns §

TREWAVAS, E.
1932 See REGAN.

TRISTRAM, H.B.
1880 Description of a new genus and species of owl from the Seychelles Islands. Ibis, ser.4, 4: 456-459, 1 pl. [Gymnoscops insularis.] N

TROPICAL PRODUCTS INSTITUTE, LONDON.
1968 See Anon.

TRUE, F.W.
1893 Description of a new species of fruit bat, Pteropus aldabrensis, from Aldabra island. Proc.U.S.natn.Mus., 16: 533-534. LUZ

1894 Notes on some skeletons and skulls of porpoises of the genus Prodelphinus, collected by Dr. W.L.Abbott in the Indian Ocean. Proc.U.S.natn.Mus., 17: 1895, 33-37. LUZ

TSURUTA, A.
1957 See CHIBA.

TURNER, H.H.
1923 See POULTON.

TURNER, R.E.
1911 Fossorial Hymenoptera from the Seychelles and other islands in the Indian Ocean. Trans.Linn.Soc.Lond.(Zool.), 14: 367-374. [In GARDINER, J.S. and others 1907-1936.] N §

TURRILL, W.B.
1917 See HEMSLEY.

TURSCH, B.
1968 See RUDIGER.

TYACK, L.A.M.
1965 Mauritius and its dependencies, the Seychelles: treasures of the Indian Ocean. Lausanne, France Inter Presse. [A beautifully illustrated short popular account of Seychelles on 131-138.] C §

TYERMAN, J.
1886 Lodoicea seychellarum (double cocoa-nut). Gdnrs' Chron., 7 August, 181. [Description of the germination of the nut, with a drawing.] N

TYLER, J.C.
1966a Mimicry between the plectognath fishes Canthigaster valentini (Canthigasteridae) and Paraluteres prionurus (Aluteridae). Notul.nat., no.386, 1-13. [Based on material from Seychelles.] LUZ

1966b A new species of serranoid fish of the family Anthiidae from the Indian Ocean. Notul.nat., no.389, 1-6. [Pteranthias winniensis from Amirantes.] LUZ

1966c A new species of damselfish (Pomacentridae) from the western Indian Ocean, Pristotis judithae. Notul.nat., no.393, 1-6. [From Mahé.] LUZ

1967 Redescription and synonymy of the Indo-Pacific plesiopid fish Barrosia altivelis. Notul.nat., no.399, 1-8. [Based partly on Seychelles material.] LUZ

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1965a General report of the participation of Japan in the International Indian Ocean Expedition: V.4. Physical oceanography. Rec.oceanogr.Wks Japan, new ser., 8: 1966, 41-71. [In HIDAKA and others (eds.). Mainly reported water temperatures, salinities, dissolved oxygen contents and currents.] LUO

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UDINTZEV, G.B.
1965a New data on the bottom structure of the Indian Ocean. Okeanologia, 5: 993-998. [In Russian.] NL
Also in IIOE Repr., 5: 1968, 709-714. [English title on ix.]

1965b Thirty-sixth cruise of RV 'Vityaz'. Okeanologia, 5: 1113-1119. [In Russian.] NL
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1965 General report of the participation of Japan in the International Indian Ocean Expedition: V.9. Fishery oceanography. Rec.oceanogr.Wks Japan, new ser., 8: 1966, 119-128. [In HIDAKA and others (eds).] LUO

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1909 Trichoptera [of the Sladen Expedition]. Trans.Linn.Soc. Lond.(Zool.), 14: 1910, 41-54, 2 pl. [In GARDINER, J.S. and others.] N §

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1967 Report to the governments of the People's Republic of Southern Yemen and the Seychelles Islands on the green turtle resource in southern Arabia, and the status of the green turtle in the Seychelles Islands . . . . Rep.FAO UNDP(TA), no.2467, 1-59. [Based on the work of HIRTH.] ns it: BAYNE et al. 1970b §

UNITED STATES: DEPARTMENT OF AGRICULTURE: BUREAU OF PLANT INDUSTRY: OFFICE OF FOREIGN SEED AND PLANT INTRODUCTION.
1914 See Anon. 1914a.

UNITED STATES: DEPARTMENT OF COMMERCE: WEATHER BUREAU.
[1942] Climatic summary for the Indian Ocean area. Spec.Rep., no. 183, 1-42. [Included data for Chagos and Seychelles.] ns it: WALLACE, J.A., jr.

1962 Monthly climatic data for the world, 1948- . . . . Asheville NC. [Included surface data for Seychelles.] ns it: WALLACE, J.A., jr.

UNITED STATES: NAVY: HYDROGRAPHIC OFFICE.
1943a Strategic aerological surveys: II. Pacific and Indian Ocean areas. Spec.Publs U.S.N.hydrogr.Off., H.O.no.222a. [Survey no.156 contained tabular data on climates of Chagos and Seychelles.] ns it: WALLACE, J.A., jr.

1943b Naval air pilot: east central Africa including Zanzibar and Seychelles Islands: weather summary. Spec.Publs U.S.N. hydrogr.Off., H.O.no.262, suppl.B, 1-120. [Included a section on the climate of Seychelles.] ns it: WALLACE, J.A., jr.

1952 Sailing directions for the south Indian Ocean including Madagascar and the islands west of longitude 90° East. Spec. Publs U.S.N.hydrogr.Off., H.O. no.161. Fourth edition. [Included data from Chagos and Seychelles.] ns it: WALLACE, J.A., jr.

1960 Summary of oceanographic conditions in the Indian Ocean. Spec.Publs U.S.N.hydrogr.Off., no.SP-53, vii plus 1-142, 1 pl. [Prepared by the Oceanographic Analysis Division of the Marine Services Department. With a map showing IIOE cruises completed and planned, 1959-1963.] LUO

USAKOVA, N.P.
1964 See POPOV.

VACQUIER, V.
1964 See Von HERZEN.

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1899 Nouveaux documents historiques sur les tortues terrestres des Mascareignes et des Seychelles. Bull.Mus.Hist.nat., Paris, 5: 19-23. [Commented on observations by DEGRANPRE, L.M.J.C., Comte.] LUZ

1903 Les tortues de terre gigantesques. Revue bleue Revue scient., Paris, 1-38. ns u

VALKHOFF, M.F.
1966 Studies in Portuguese and Creole with special reference to South Africa. Johannesburg, Witwatersrand University Press. [Seychelles in ch.4.] LUC §

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1901 Bericht über die bei der Deutschen Tiefseeexpedition beobachteten Vögel. J.Orn., Lpz., 49: 304-322, 1 pl. [From the 'Valdivia' expedition.] N

1902a Die acraspeden Medusen der Deutschen Tiefsee-Expedition 1898-1899. Valdivia Rep., 3: 1-52, 8 pl. Z

1902b Die craspedoten Medusen der Deutschen Tiefsee-Expedition 1898-1899: I. Trachymedusen. Valdivia Rep., 3: 53-86, 4 pl. Z

1907 Die Narcomedusen [of the German Deep-sea Expedition]. Valdivia Rep., 19: pt.1, 1908, 41-74, 3 pl. Z

1910 Die Anthomedusen und Leptomedusen der Deutschen Tiefsee-Expedition 1898-1899. Valdivia Rep., 19: pt.1, 1911, 191-233, 1 pl. Z

VANMEERBECK, E.
1874 Report on the Smaller Dependencies. [Port Louis.] 2 vol. C: in catalogue but missing

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VAUGHAN, R.E.
1939 The Museum. Rep.Maurit.Inst., 1939 and 1940, 6-10. [Mentioned land shells collected by J.Closel from Diego Garcia, bringing the number of species known therefrom to twenty.] N

1940 See HUBBARD.

VAURIE, C.
1948 See MAYR.

1949 A revision of the bird family Dicruridae. Bull.Am.Mus.nat. Hist., 93: 199-342. [D.aldabranus on 231-232.] LUZ

1963 Systematic notes on the cattle egret (Bubulcus ibis). Bull.Br. Orn.Club, 83: 164-166. [Discussed three specimens of a Seychelles variety.] NL §

VEEVERS-CARTER, M.
1962 The development of the green turtle (Chelonia mydas) fisheries of the Seychelles. Victoria, Department of Agriculture. ns u §

VEEVERS-CARTER, Wendy.
1966 Life in the outer islands: Rémire Island in the Amirantes Group. Seychelles Annual, 20-24. [Also called Eagle Isle.] O §

1970 Island home. New York and Toronto, Random House. [Life of a lady anthropologist on Rémire (or Eagle) Island.] ns u

VELAIN, C.
1879 Notes sur la constitution géologique des îles Seychelles. Bull.Soc.géol.Fr., ser.3, 7: 278-285. N §

1880 Mission de l'île Saint-Paul: météorologie: recherches géologiques faites à Aden, à la Réunion, aux îles Saint-Paul et Amsterdam, aux Seychelles. In: Recueil de mémoires, rapports et documents relatifs à l'observation du passage de Vénus sur le soleil, 2: pt.2, 1-460, 27 pl. Paris, Gauthier-Villar for Académie des Sciences. N

Announced in C.r.hebd.Séanc.Acad.Sci., Paris, 91: 1880, 686-687. N

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1902 Chilopoda. In: Klassen und Ordnungen des Tier-Reichs, edited by H.G.Bronn, 5: pt.2, 1925, 1-725, 30 pl. Leipzig, Winter. ns

New edition, 1925. Akademische Verlagsgesellschaft. [Geographical distribution in ch.8; Lithobius seychellarum mentioned on 683, 685.] N

1939a Diplopoden des Insel Mauritius und ihre zoogeographische Bedeutung. Jena,Z.Naturw., 73: 37-96, 5 pl. [Included nineteen Seychelles species.] N

1939b Chilopoden der Insel Mauritius. Zool.Jb., 72: 71-98, 2 pl. [Seychelles species included in discussion.] N

VERSCHAFFELT, A.
1865 See LEMAIRE.

VESEY-FITZGERALD, L.D.E.F.
1936a Address to the planters of Seychelles, 23 March. Victoria, Department of Agriculture. ns u §

1936b Birds of the Seychelles and other islands included within that Colony. Victoria, Government Printer. [Contained an annotated list.] N §
Also included as an appendix in BRADLEY 1940, 2:.

1938 Biological notes on some Coccinelidae from East Africa. Bull. ent.Res., 29: 185-189. [Material collected during a search for predators on coccids for use in Seychelles.] LUTM §

1940a Notes on some Coccinelidae (Col.) from islands in the Indian Ocean. Bull.ent.Res., 31: 191-192. [Two predators on coccids described from Aldabra and Seychelles groups.] LUTM §

1940b The control of Coccidae on coconuts in Seychelles. Bull.ent. Res., 31: 253-283, 2 pl. N §
Abstracted in Rev.appl.Ent., ser.A, 29: 1941, 323-324. N

1940c On the vegetation of the Seychelles. J.Ecol., 28: 465-483, 3 pl. LUB §

1940d Further contribution to the ornithology of the Seychelles Islands. Ibis, ser.14, 5: 1941, 518-531. P §

1941a Melittomma insulare Fairm., a serious pest of coconut in the Seychelles. Bull.ent.Res., 31: 383-402, 2 pl. E §

1941b Some insects of economic importance in the Seychelles. Bull. ent.Res., 32: 153-160. [Contained an annotated list of over fifty species.] N §
Abstracted in Rev.appl.Ent., ser.A, 30: 1942, 214. N

1941c Progress of the control of coconut-feeding Coccidae in Seychelles. Bull.ent.Res., 32: 161-164. N §
Abstracted in Rev.appl.Ent., ser.A, 30: 1942, 214. N

1942a Further studies of the vegetation on islands in the Indian Ocean. J.Ecol., 30: 1-16. [Aldabra group, Amirantes, Farquhar and St. Pierre.] NL §

1942b See BAILEY, L.H.

1947 Reptiles and amphibians from the Seychelles Archipelago. With an appendix by PARKER, H.W. Ann.Mag.nat.Hist., ser.11, 14: 577-584. [Discussed changes in fauna during thirty years.] LUZ §

1950 Nesting habits of some aculeate Hymenoptera in the Seychelles. Proc.R.ent.Soc.Lond., ser.A, 25: 75-80, 1 pl. [Mainly about mason wasps.] N §

1953a Review of the biological control of coccids on coconut palms in the Seychelles. Bull.ent.Res., 44: 405-413. [Effect of introducing coccinellids.] LUTM §

1953b Wild life in Seychelles. Oryx, 2: 28-32. [Mainly about birds.] N §

VESEY-FITZGERALD, L.D.E.F. and BETTS, F.N.

1940 The birds of the Seychelles. Ibis, ser.14, 4: 480-504, 2 pl. [With an appendix on birds of the Aldabra group, 486-489.] P §

VIADER, R.

1937 Revised catalogue of the testaceous Mollusca of Mauritius and its dependencies. Bull.Maurit.Inst., 1: pt.2, 1-111, 1 pl. [Contained a review of previous work.] N §

1938 Descriptions of nine marine shells from Mauritius and its dependencies. Bull.Maurit.Inst., 1: pt.3, 4-8, 2 pl. [Included three Chagos species.] N §

1951 New or unrecorded shells from Mauritius and its dependencies. Bull.Maurit.Inst., 3: pt.2, 127-155, 5 pl. [Included Seychelles species and one from Diego Garcia.] N §

VIETTE, P.

1958 Note sur de petites collections de lépidoptères récoltés aux îles Comores et en Aldabra. Lambillionea, 58: 60-65. [Aldabra material collected by C.Prola.] N §

1962 Noctuelles trifides de Madagascar: écologie, biogéographie et taxonomie (Lép.). Annls Soc.ent.Fr., 131: pt.1, 1-294, 10 pl.; pt.2 not available. [Affinities with Seychelles on 71; theories of biogeography on 74-75; Aldabra species mentioned on 104, 106, 231.] N [pt.1]

1963 Le complexe de "Prodenia litura" (Fabricius) dans la région malgache (Lep.Noctuidae). Bull.mens.Soc.linn.Lyon, 32: 145-148. [Divided it into two species of Spodoptera, one of which is found in Aldabra and Seychelles.] N

1970 Note sur quelques espèces d'Achaea de la région malgache [Lep.Noctuidae Catocalinae]. Lambillionea, 70: 50-54. [Included the misnamed A.seychellarum Holland 1895 from Aldabra and Cosmoledo.] NL §

VILLIERS, A.J.
1952 The Indian Ocean. London, Museum Press. B §
Also as: Monsoon seas: the story of the Indian Ocean. New York, McGraw Hill. [With different illustrations.] B

VINCENT, J.
1969 See FISHER, J.M.M.

VINOGRADOV, M.E.
1961a See BELJAEV.

1961b See BOGOROV.

1962 On the quantitative distribution of deep-water plankton in the northern part of the Indian Ocean. Okeanologia, 2: 577-592. [In Russian.] NL
Also in IIOE Repr., 2: 1966, 317-332. [English title on viii.]

1966 See BOGOROV.

VINOGRADOV, M.E. and VORONINA, N.M.
1961 Distribution of some widespread species of copepods in the Indian Ocean. Dokl.Akad.Nauk SSSR, 140: 219-222. [In Russian.] NL
Also in IIOE Repr., 2: 1966, 153-156. [English title on vii.]

1962 The distribution of different groups of plankton in accordance with their trophic level in the Indian equatorial current area. Rapp.P.-v.Réun.Cons.perm.int.Explor.Mer, 153: 200-204. LUO
Extracted in English in IIOE Repr., 2: 1966, 431-436.

VINOGRADOV, M.E., VORONINA, N.M. and SUHANOVA, I.N.

1961 Horizontal distribution of tropical plankton and its relation to certain features of the environment in the open part of the ocean. Okeanologia, 1: 283-293. [In Russian.] NL

Also in IIOE Repr., 2: 1966, 157-167. [English title on vii.]

VINOGRADOVA, M.G.

1961 See BELJAEV.

VINSON, J.L.J.

1934 Contribution à l'étude des coléoptères des îles Mascareignes. Trans.R.Soc.Arts Sci.Maurit., ser.C, no.3, 1935, 154-216, 1 pl. [Contained a discussion of theories of origin of the islands; a list of Coleoptera with geographical distribution; analysis and discussion.] N §

1936 Les coccinelles des îles Mascareignes. Revue agric.Ile Maurice, no.85, 19-28. ns it

Reprinted separately: Port Louis, Esclapon. [Included Aldabra, Providence and Seychelles species.] E

1938 Catalogue of the Lepidoptera of the Mascarene Islands. Bull. Maurit.Inst., 1: pt.4, 1-69. [Contained a comparison with Seychelles.] N §

1946 Les arthropodes aptères récoltés à l'île Maurice par le Dr. Lawrence en 1934-35. Trans.R.Soc.Arts Sci.Maurit., ser.C, no.13, 7-15. [Included Seychelles species of Amphipoda, Isopoda, Arachnida and Myriapoda.] N §

1949 L'île Ronde et l'île aux Serpents. Proc.R.Soc.Arts Sci. Maurit., 1: pt.1, 1950, 32-52, 4 pl. [Mentioned the occurrence of the giant tenebrionid beetle Pulposipes herculeanus on Round Island, near Mauritius, and Frigate Island, Seychelles, though he was unable to find it; mentioned also two scorpions, a spider and several birds found in Seychelles.] Z §

1952 See ROUNTREE.

1956-1962 Catalogue of the Coleoptera of Mauritius and Rodriguez. Bull.Maurit.Inst., 4: pt.1, 1956, 1-73; pt.2, 1958, 75-130; pt.3, 1960, 131-196; pt.4, and suppl.1, 1962, 197-297. [Contained Agalegas, Chagos and Seychelles species.] N §

1963a On a few longicorn beetles, mainly from Mauritius. Bull. Maurit.Inst., 5: pt.7, 269-285, 3 pl. [Included a Seychelles species.] N §

1963b Sur la disparition progressive de la flore et de la faune de l'île Ronde. Proc.R.Soc.Arts Sci.Maurit., 2: 1964, 247-261, 2 pl. [Questioned whether the giant tenebrionid Pulposipes herculeanus, which had been recorded on Round Island, near Mauritius, as well as Frigate Island, Seychelles, had ever occurred on Round Island.] NL §

1967 Liste chorologique des coléoptères des Mascareignes. With an introduction by PAULIAN, R. Bull.Maurit.Inst., 4: 299-372. [Referred to Aldabra and Seychelles species.] N §

1968 Les blattoptéroides, orthoptéroides et dermaptéroides des Mascareignes. Bull.Maurit.Inst., 6: pt.3, 103-118. [Mentioned species from several other islands in the region.] N §

VINTOVKIN, V.R.
1964 See IVANENKOV.

VOELTZKOW, A.
1896 See FRIEDEL.

1897 Einleitung: Madagascar, Juan de Nova, Aldabra. Abh.senckenb. naturforsch.Ges., 21: 1-76, 10 pl. [In VOELTZKOW and others 1897-1905. Juan de Nova is Farquhar.] N

1902a Uber Coccolithen und Rhabdolithen nebst Bemerkungen über den Aufbau und die Entstehung der Aldabra-Inseln. Abh.senckenb. naturforsch.Ges., 26: 465-537. [In VOELTZKOW and others 1897-1905.] LUZ

1902b Die von Aldabra bis jetzt bekannte Flora und Fauna. Abh. senckenb.naturforsch.Ges., 26: 539-565. [In VOELTZKOW and others 1897-1905. Contained systematic and bibliographical lists including species from Amirantes and Seychelles.] LUZ

1903 Berichte über eine Reise nach Ost-Afrika zur Untersuchung der Bildung und des Aufbaues der Riffe und Inseln des westlichen indischen Ozeans: I. Die Witu-Inseln. Z.Ges.Erdk.Berl., 560-572. [Aldabra mentioned on 568.] S

VOELTZKOW, A. and others.
1897-1905 Wissenschaftliche Ergebnisse der Reisen in Madagaskar und Ostafrika in den Jahren 1889-95. Abh.senckenb. naturforsch.Ges., 21: 1897-1899, 1-664, 41 pl.; 26: 1899-1902, 1-586, 40 pl.; 27: 1902-1905, 1-392, 48 pl. [Included Aldabra, with some Amirantes and Seychelles material also.] N

VOELTZKOW, A. and others.
1906-1923 Reise in Ostafrika in den Jahre 1903-1905 . . . wissenschaftliche Ergebnisse. ["Wiss.Ergebn.Reise Ostafr.1903-5".] Stuttgart, Schweizerbart. 5 vol. [Mainly about

Comoros but included Aldabra and referred to Seychelles.] N

VOGT, P.R.
1965 See BOWIN.

VOOUS, K.H.
1966 Prions in the tropical Indian Ocean. Ardea, 54: 89. [Report of an observation of Pachyptila near the northern end of the Mozambique Channel.] N

VORONINA, N.M.
1961a See VINOGRADOV.

1961b See VINOGRADOV.

1962a On distribution of macroplankton in the northern half of the Indian Ocean. Okeanologia, 2: 118-125. [In Russian.] NL
Also in IIOE Repr., 2: 1966, 296-303. [English title on viii.]

1962b On the surface plankton of the Indian Ocean. Trudȳ Inst. Okeanol., 58: 67-79. [In Russian.] NL
Also in IIOE Repr., 2: 1966, 461-473. [With a summary in English.]

1962c See VINOGRADOV.

WABY.
1910 Coco-de-mer in British Guiana. Kew Bull., 256-257. [Reported that imported plants were growing there successfully.] N

WAGLER, E.
1922 Amphipoda: II. Scinidae der Deutschen Tiefsee-Expedition. Valdivia Rep., 20: pt.2, 1926, 317-446. Z

WALCKENAER, C.A., Baron, and GERVAIS, F.L.P.
1836-1847 Histoire naturelle des insectes: aptères. Paris, Robert. 4 vol. and atlas. [Julus seychellarum, by Gervais, in 4:1847, 172.] N

WALKER, A.O.
1908 Amphipoda Gammaridea from the Indian Ocean, British East Africa and the Red Sea. Trans.Linn.Soc.(Zool.), 12: 1909, 323-344, 2 pl. [In GARDINER, J.S. and others 1907-1936.] N §

1909 Amphipoda Hyperiidea of the 'Sealark' expedition to the Indian Ocean. Trans.Linn.Soc.Lond.(Zool.), 13: 49-55. [In GARDINER, J.S. and others 1907-1936.] N §

WALKER, H.J.
1967 Economic and social change in the Seychelles. Geogrl Rev., 57: 429-431. [A short succinct article.] LUA

WALLACE, A.R.
1876 The geographical distribution of animals . . . . London, Macmillan. 2 vol. Z

1880 Island life . . . . London and New York, Macmillan. ns it
Second edition, revised, 1892. Z §
Third edition, 1911. ns

WALLACE, J.A., jr.
1963 An annotated bibliography on the climate of the Indian Ocean islands. Washington DC, US Department of Commerce: Weather Bureau, Publ.WB/BC-70, xx plus 1-63. [Items were divided chronologically into decades and then alphabetically by author, with serials at the end, and numbered; the annotations were very full; and then there were author, region and subject indexes.] M

WALLEN, I.E.
1964 The International Indian Ocean Expedition: a status report. J.Wash.Acad.Sci., 54: 45-52. Z

WALSH, J.
1967a Aldabra: biology may lose a unique island ecosystem. Science, N.Y., 157: 788-790. LUZ

1967b Aldabra: reprive for an island. Science N.Y., 158: 1164. LUZ

WALTER, A.
1927 Results of observations on the direction and velocity of the upper air current over the south Indian Ocean. Geophys.Mem., Lond., 4: no.39, 1-32. [Records of an anticyclonic belt between latitudes 18 and 40°S. which was thought to control atmospheric conditions in the whole of the region.] University of Reading

WALTER, A. (ed.).
1921 The Mauritius almanac and commercial handbook for 1921. Port Louis, General Printing and Stationery Co. [Other islands in the region described on 15-20.] G §

WARBURTON, C.
1912 The Acarina of the Seychelles. Trans.Linn.Soc.Lond.(Zool.), 15: 349-360, 3 pl. [In GARDINER, J.S. and others 1907-1936.] N §

WARD, B.
1962 Game fishing in Seychelles. Seychelles Annual, no.4, 33-37. T §

WARD, M.
1942a A new genus and eight new species of Brachyura from Mauritius and the Chagos Archipelago. Bull.Maurit.Inst., 2: pt.2, 39-49, 3 pl. N

1942b Notes on the Crustacea of the Desjardins Museum, Mauritius Institute, with descriptions of new genera and species. Bull. Maurit.Inst., 2: pt.2, 49-113, 2 pl. [Included Chagos species.] N

WARD, S.
1863 On the double cocoa-nut of the Seychelles, Lodoicea seychellarum. J.Linn.Soc.(Bot.), 8: 1865, 135-139. [A letter to Sir William Hooker. See also CREPIN.] N
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INDEXES

SUBJECTS

Aerology, climatology, meteorology 251
Agriculture, forestry, horticulture 252
Bibliography 253
Biogeography, ecology: general, including conservation 253
Biography, autobiography 254
Botany 254
Coral islands, coral reefs 256
Demography 258
Economics, commerce, industry: general 258
Education 259
Ethnology, physical anthropology 259
Fisheries, turtle fisheries, whaling 259
Geographical, historical and general accounts; navigation 260
Geology, palaeontology, palaeogeography, geochemistry, mineralogy, petrography, soil science 261
Geophysics, geodesy 262
Hydrology, hydrography 263
Industries: essential oils 264
Industries: other 264
The land-bridge and continental-drift problems 264
Linguistics 265
Medicine, pharmacy 265
Mythology 266
Oceanology and oceanography: general 266
Official reports : general 267
Satellite tracking 267
The sea bottom 267
Sociology 268
Voyages, explorations and expeditions: general narratives and reports 268
Zoology 270

2. REGIONS

Agalega Islands 278
Aldabra group 278
Amirantes group, including Alphonse and Desroches Islands 281
Chagos group 282
Coetivy Island 284
Farquhar group 284
Providence group 285
Seychelles group, Platte Island, Seychelles and Swift Banks 285
Western Indian Ocean and islands: general, including Fortune and Saya de Malha Banks 294

3. TAXA

Plants: general 303
Thallophyta, including phytoplankton 303
Bryophyta 304
Pteridophyta 304
Palmae 304
Other Spermatophyta 305
Plankton and zooplankton: general 306
Animals: general 307
Protozoa 307
Parazoa (Porifera) 307
Cnideria (Coelenterata) 308
Platyhelminthes 308
Nemertina 309
Nematoda 309
Polyzoa (Bryozoa) 309
Brachiopoda 309
Mollusca 309
Gephyrea 310
Annelida 310
Myriapoda 310
Insecta: general 311
Apterygota 311
Ephemeroptera 311
Odonata 311
Isoptera 311
Orthoptera, including Dictyoptera and Phasmida 311
Dermaptera 312
Embioptera 312
Psocoptera (Copeognatha) 312
Phthiraptera 312
Thysanoptera 312
Hemiptera 312
Neuroptera 312
Coleoptera 313
Trichoptera 313
Lepidoptera 313
Diptera 314
Siphonaptera (Aphaniptera) 314
Hymenoptera 314
Crustacea: general 315
Copepoda 315
Cirripedia 315
Ostracoda 315
Peracarida 315
Hoplocarida (Stomatopoda) 316
Eucarida 316
Arachnida 316
Pycnogonida 316
Chaetognatha 317
Echinodermata 317
Urochordata 317
Cephalochordata 317
Vertebrata: general 317
Fishes 318
Amphibia 319
Reptilia 319
Aves 320
Mammalia 321

1. SUBJECTS

Aerology, climatology, meteorology

Anon. 1916, 1919b, 1962e
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Biogeography, ecology: general, including conservation

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Winckworth 1940
Woltereck 1912
Wood, E.J.F. 1963
Wright, C.A. 1969
Wright, E.P. 1868b, 1869a, 1869b, 1870a, 1870b, 1874, 1876, 1877, 1879
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2. REGIONS

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Bojer 1835, 1837, 1841, 1871
Bouffé 1913
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Choisy 1849
Dussercle 1949
Fauvel, A.A. 1900a
Gibson-Hill 1952
Greathead 1971
Guérin 1952
Hemsley 1913
--- et al. 1919
Laplace 1841-1854
Le Duc, A. 1841
Leduc, S.E. 1897-1906
Lincoln 1893a, 1893b
Lionnet, J.G. 1922, 1924
Mamet 1936
Mauritius: Observatory Department 1953-1958
Miller, N.C.E. 1956
Newnham 1949
Pelte 1952
Picault 1742-1744
Pike 1873
Poisson 1953
Reyne 1938
Rountree et al. 1952
Scott, R. 1961
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Toussaint 1951
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Viader 1937
Vinson 1952, 1956-1962
World Meteorological Organization 1953

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Alston 1925
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Arnoult et al. 1958
Atwood 1942
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Badcock 1970
Baker, J.G. 1894
Balle 1964
Barnacle 1962
Barnes, J. et al. 1969
--- et al. 1970
Basilewsky 1970
Baty 1895
Bauchot-Boutin 1958
Bauer 1911
Bayne et al. 1970a, 1970b
Beamish 1967, 1968a, 1970
Beier 1940
Bellamy 1969, 1970
--- et al. 1969
Beltz 1953, 1954, 1958, 1960
Bendire 1894
Benson 1960a, 1962, 1967, 1968, 1970b, 1970d, 1970d, 1970f
--- et al. 1968, 1969
Berio 1956, 1959, 1962
Von Berlepsch 1898
Berlioz 1946
Bernardi 1959, 1968
Blackman ed. 1966
--- et al. 1967
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Blake et al. 1942
Blanc 1971
Boettger 1913
Bonnetard 1921
Borradaile 1910

Boulenger 1911
Boulton 1960
Bourgogne 1963
Bourne, W.R.P. 1963, 1970b
Brander 1969
--- et al. 1970
Brown, E.S. 1956
Brown, N. 1967
Bruce 1966
Burton 1967
Calvert 1898
Campbell 1970
Carlquist 1965
Carr 1970
Champion 1917
Chave 1967
Cherbonnier 1964
Chittick 1968
Christensen 1912
Clancey 1968
Cockerell 1911
Cogan 1970a, 1970b
--- et al. 1969
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Connolly 1925
Cousteau 1959
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Dawson 1966a
De Toulgoët 1965
Diakonoff 1969
Diamond 1969a, 1969b, 1970a, 1970b
Diolé 1971
Dixon, C. 1898
Döderlein 1902
Drew 1969a, 1969b, 1970
Dupont, P.R. 1907, 1911
Ehlers 1897
Fairmaire 1896
Falck 1965
Farrow 1969a, 1969b, 1970
--- et al. 1969
Fiddick 1968
Forel 1897, 1912
Forster et al. 1970
Fosberg 1967, 1969a, 1969b, 1969c
--- et al. 1970b, 1970c, 1970d
Frappa 1937
Frazier 1970a, 1970b, 1971
Frere 1874
Friedel 1896
Friese 1900
Fryer 1908, 1909a, 1909b, 1909c, 1909d, 1910a, 1910b, 1911
Gadow 1892
Gardiner, J.S. et al. 1908, 1909
--- et al. 1909
Gaymer 1966a, 1966b, 1966c, 1967a, 1967b, 1967c, 1967d, 1967e,
---et al. 1965
Gibson-Hill 1950a, 1950b
Grandidier et al. 1845-1902
Grant, C.H.B. et al. 1933
Great Britain: Colonial Office 1889-1890
Great Britain: Secretary of State for Foreign Affairs 1966a
Griffith et al. 1893
Grote 1928
Grouvelle 1917
Grubb 1969a, 1969b, 1970a, 1970b
Guérin 1952
Guilcher 1969
Guinot 1964
Günther 1877, 1879
Gwynne et al. 1969
Hampson 1908
Hartman 1958
Heck 1957
Hemsley 1913, 1916b
--- et al. 1917
--- et al. 1919
Herbulot 1962b
Hermitte 1931
Hill, J.E. 1969
Hillaby 1967
Hirth et al. 1970
Holland 1895
Honegger 1966a, 1966d, 1968
Hooker, Sir J.D. et al. 1874
Hughes 1971
Humphreys, W.F. 1970
Hutchinson 1927
Hutson 1969, 1970a, 1970b
Jatzow et al. 1898
Jeffrey 1966
Jones, D.J. 1969a, 1969b, 1970
Keller 1898, 1901

Kenyon 1970
Keraudren 1966
Kirk 1874
Klapálek 1913
Kohn 1967
Kolbe, H.J. 1902
Le Cerf 1916
Legrand 1958, 1964b, 1965, 1971
Lenz 1898, 1905, 1910
Lévi 1961
Linell 1896
Lionnet, J.F.G. 1952a, 1967, 1970c
Longbottom 1970
Von Lorenz-Liburnau 1898
Loveridge et al. 1957
Lowery 1969
Ludwig 1898
Ludwigson 1967
Lythgoe 1969a, 1969b, 1970
Maa 1970
McConville 1967
McKenzie 1969a, 1969b
Mackworth-Praed 1933
McLeod 1970
Macnae 1969
Mancini 1971
Mamet 1957
Matthew 1932
Mattingly et al. 1956
Maulik 1917
Mayr et al. 1948
Meade-Waldo 1908
Merrett 1970
Michel 1948
Miller, G.S. 1902
Moine 1970
Moreau, R.E. 1960, 1966
Morris 1963
Newman, W.A. 1967
Newton, A. 1874
Nicoll 1906a, 1908
Niejahr 1876
"N.M.S." 1967
Ormond et al. 1970
Owen, Sir R. 1874
Oxford and Asquith 1965
Palombelli 1954
Paulian 1967
Peake 1970
Pelte 1952
Penny, M.J. 1965d, 1965e, 1968b, 1969a, 1969b
--- et al. 1969
Peterson 1968, 1970
Piggott 1961a
Pike 1873
Pinhey 1967
Poore 1970b, 1970c
Potts, G.W. 1969, 1970
Price 1969
Prosperi 1955
Purcell 1931
Rathbun 1894
"R.E." 1878
Regan 1912
Régimbart 1900
Renvoize 1969, 1970b, 1970c, 1970d, 1971
Reyne 1938
Ridgway 1893, 1894a, 1894b
Rosen 1970a
--- et al. 1969
Rothschild 1915
Rountree et al. 1952
Roux-Estève 1958
Saint John 1960
Salomonsen 1933
Sandberg 1967
Sauzier 1893
Schaffer 1969
Van Schauburg 1935
Schinz 1897
Schoenichen 1908
Sclater, P.L. 1871
Sclater, W.L. 1912
Scott, H. 1917b, 1921a, 1925a
Seychelles: Department of Agriculture annual
Seychelles: Government (Bonnetard) 1921
--- (Michel) 1948
--- (Purcell) 1931
Seychelles: Labour and Welfare Department annual
Seychelles: Medical Department annual
Shelley 1896-1912
Siebenrock 1903
Sjögren 1971a
Smith, J.L.B. 1955b, 1955-1958 1956b, 1956f, 1957a, 1958a

Somerville 1909
Spurs 1890
Stejneger 1893
Stoddart, D.J. 1969
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1967b, 1967c, 1968a, 1968b,
1968c, 1968d, 1969b, 1969c,
1969d, 1969e, 1970a, 1970b,
1970c, 1971j
--- ed. 1967, 1970
--- org. 1969
--- et al. 1970
--- et al. 1969
--- et al. 1969
--- et al. 1967a, 1967b
Strand 1907
Taylor, J.D. 1969a, 1969b,
1969c, 1970a, 1970b
Thiele 1900
Thomson, K.S. 1970
Thorpe 1967
Tornquist 1904
Travis 1959
True 1893
Turrill 1917
Vaurie 1948, 1949
Vesey-Fitzgerald 1940a, 1942a
Viette 1958, 1962, 1963, 1970
Vinson 1936, 1952, 1967
Voeltzkow 1896, 1897, 1902a,
1902b, 1903
--- et al. 1897-1905
--- et al. 1906-1923
Walsh 1967a, 1967b
Wasmann 1897
Webb 1960b
Westoll 1969
--- et al. org. 1969
Wharton 1878, 1883
White 1950
Whitton 1969a, 1969b, 1970
Williams, E.E. 1952, 1954
Williams, J.G. 1952
Wood, D. 1969
Wright, C.A. 1967a, 1967b, 1967c
Zinn 1967

Amirantes group, including Alphonse and Desroches Islands

Anon. 1970
Arrow 1922
Barnacle 1962
Benson 1970e
Blanc 1971
Bonnetard 1921
Boschma 1948
Boulton 1960
Braithwaite 1968
Brown, E.S. 1956
Bruce, A.J. 1969a
Cooper 1907
Davis 1918
Dawson 1966a
De Froberville 1848
Dufo 1840
Edmondson 1923
Engel, Celeste G. 1967
Fisher R.L. et al. 1967
Forel 1907
Fosberg et al. 1970e,
1970f, 1970g
Gardiner, J.S. 1905b
--- et al. 1907
Gaymer 1966b
Great Britain: Secretary of
State for Foreign Affairs 1966a
Guérin 1940
Gwynne et al. 1969
Hampson 1907
Hemsley et al. 1919
Hilde 1967
Holdhaus 1929
Jouanin 1957
Leont'yev 1968
Ludwig 1898
Mancini 1971
Mattingly 1956
Michel 1948
Moine 1970
Peterson 1970
Piggott 1961a
Pike 1873
Pocklington 1967
Poore 1970d, 1970e, 1970f
Purcell 1931

Renvoize 1970e, 1970f, 1970g, 1971
Ridley, M.W. 1956
Sedgwick 1905b
Seychelles: Department of Agriculture annual
Seychelles: Government (Bonnetard) 1921
--- (Michel) 1948
--- (Purcell) 1931
Seychelles: Labour and Welfare Department annual, triennial
Seychelles: Medical Department annual

Simroth 1910
Snell et al. 1920
Stoddart, D.R. 1970a
--- ed. 1970
--- et al. 1970b, 1970c, 1970d
Tams 1920
Travis 1959
Tyler 1966b
Veevers-Carter, Wendy 1966, 1970
Vesey-Fitzgerald 1942
Voeltzkow 1902b
--- et al. 1897-1905
Webb 1960b
Winckworth 1940
Wood, D. 1969

Chagos group

Ackroyd 1876, 1877a, 1877b, 1878a, 1878b
Adolphe 1956
Andrews 1909
Arrow 1922
Aurivillius 1922
Atwood 1942
Barnard, K.H. 1964
Beier 1940
Benson 1969
Berkeley et al. 1859
Bernard, H.M. 1896, 1897, 1905
Bezrukov 1963a
Blackman et al. 1967
Blake et al. 1942
Blasius 1887
Bojer 1837, 1841
Bolivar 1924a
Boschma 1948, 1957, 1959
Boucherat 1888
Bourne, G.C. 1886a, 1886b, 1888a, 1888b
Bourne W.R.P. 1962, 1971
Brook 1893
Brooks, E.P. 1876
Brown, E.S. 1956
Bullock 1971
Caldwell, J. 1859
Clark, A.M. et al. 1971
Cooper 1907

Coutière 1929
Daly 1934
Darwin 1893
Davis 1918
De Froberville 1848
Döderlein 1906
Dupont, I. 1881, 1883, 1884a, 1884b, 1885
Dussercle 1934, 1935, 1936, 1937
Edmondson 1923
Elkington 1929, 1930
Farquhar 1900
Finsch 1887
--- et al. 1887
Fischer, P. 1891
Forel 1907
Fosberg et al. 1971
Gardiner, J.S. 1901, 1903, 1905a, 1905b, 1906c, 1914b, 1931b, 1936a
--- et al. 1907
Gibson-Hill 1950b
Gorsky 1957
Great Britain: Air Ministry: Meteorological Office 1927, 1940-1943
Great Britain: Secretary of State for Defence 1967
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Greathead 1971
Hampson 1907
Hardinge 1860
Hemsley 1884, 1886
--- et al. 1919
Herchenroder 1944
Von Hohenzollern [1928]
Holdhaus 1929
Hoyt 1967
India: Meteorological Department 1945
Jaeckel 1930
Jarvis 1921
Joyce 1948
Keisler 1906
King, P.P. et al. 1839
Knoll 1941
Kohn 1964, 1967, 1968
--- et al. 1968
Kraepelin 1902
Laidlaw 1902
Lambrecht 1970b
Leloup 1941, 1953
Liénard 1877
Leont'yev 1968
Loustau-Lalanne 1961a
Madge 1946
Mamet 1941, 1954b
Mattingly 1956
Mauritius: Observatory Department 1953-1958
Meyrick 1910
Moresby 1838
Orian 1959
Ozawa 1965
--- et al. 1965
Pax 1909
Peake 1971
Pike 1873
Pinhey 1967
Plomley 1968
Pocklington 1967
Poisson 1953
Poulton 1923
Powell, L. 1908
Prain 1890
Reichs-Marine-Amt 1909
Reyne 1938
Rhyne 1971
Ripley 1968, 1971
Robertson 1968
Rochford 1964
Rosen 1971
Roskill 1954-1961
Ryan 1864
Salomonsen 1933
Saunders 1886
Sauzier 1895
Scott, H. 1921a
Scott, R. 1961
Sedgwick 1905b
Seno 1965
Silberrad 1969b
Sims, R. 1971
Smith, W.A. 1971
Snell et al. 1920
Stoddart, D.R. 1971a, 1971b, 1971c, 1971d, 1971e, 1971f, 1971g, 1971h
--- et al. eds. 1971
Tams 1920
Taylor, J.D. 1971a, 1971b, 1971c, 1971d
--- ed. 1971
Thiele et al. 1930
Thompson, J.A. 1950
Toussaint 1951, 1968, 1971
--- et al. 1956
Townsend, C.C. 1971
Turner 1923
Uda 1965b
Ueda et al. 1965
United States: Department of Commerce: Weather Bureau [1942]
United States: Navy: Hydrographic Department 1943a, 1952
Vaughan 1939
Viader 1937, 1938, 1951
Vinson 1956-1962
Ward, M 1942a, 1942b
Wheeler 1959
White 1950
Wiehe 1942
Willis, J.C. et al. 1901, 1931
Wilson, R.F.M. 1888
Winckworth 1904

Coetivy Island

Ackroyd 1876
Barnacle 1962
Blanc 1971
Bonnetard 1921
Boschma 1957
Brown, E.S. 1956
Cooper 1907
Edmondson 1923
England 1925
Gardiner, J.S. 1905b
--- et al. 1907
Gwynne et al. 1969
Hampson 1907
Joseph 1937
Jouanin 1957
Mattingly 1956
Michel 1948
Pike 1873
Purcell 1931
Ryan 1864
Sedgwick 1905b
Seychelles: Department of Agriculture annual
Seychelles: Government (Bonnetard) 1921
--- (Michel) 1948
--- (Purcell) 1931
Seychelles: Labour and Welfare Department annual, triennial
Seychelles: Medical Department annual
Webb 1960b
Wood, D. 1969

Farquhar group

Anon. 1970
Badcock 1970
Barnacle 1962
Benson 1970a
Blanc 1971
Bonâme 1909
Boschma 1957
Boulton 1960
Bruce, A.J. 1966
Cooper 1907
Dawson 1966a
Edmondson 1923
Farquhar 1900
Fauvel, A.A. 1900a
Forel 1907
Forster et al. 1970
Fosberg et al. 1970a
Gardiner, J.S. 1905b, 1914b
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Great Britain: Secretary of State for Foreign Affairs 1966a
Grossin 1742-1744
Gwynne et al. 1969
Hartman 1958
Hemsley et al. 1919
Lieutard 1868
Longbottom 1970
Merrett 1970
Michel 1948
Moine 1970
Neumann, L.G. 1907
Picault 1742-1744
Pocklington 1967
Poore 1970a, 1971
Purcell 1931
Renvoize 1970a, 1971
Sedgwick 1905b
Seychelles: Department of Agriculture annual
Seychelles: Government (Bonnetard) 1921
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Seychelles: Medical Department annual
Stoddart, D.R. 1967b, 1970a
--- ed. 1970
--- et al. 1970
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Thomson, K.S. 1970
Travis 1959
Vesey-Fitzgerald 1942a
Voeltzkow 1897
Webb 1960b
Wood, D. 1969

Providence group

Badcock 1970
Benson 1970a
Bonnetard 1921
Boschma 1957, 1959
Butler 1884
Cooper 1907
Dawson 1966a
Dupont, P.R. 1907, 19261
Forster et al. 1970
Gardiner, J.S. 1905b
--- et al. 1907
Hemsley et al. 1919
Linell 1896
Longbottom 1970
Merrett 1970
Michel 1948
Neumann, L.G. 1907
Piggott 1961a
Purcell 1931
Sedgwick 1905b
Seychelles: Department of Agruculture annual
Seychelles: Government (Bonnetard) 1921
--- (Michel) 1948
--- (Purcell) 1931
Seychelles: Labour and Welfare Department annual, triennial
Seychelles: Medical Department annual
Stoddart, D.R. 1967b
--- et al. 1970
Thomson, K.S. 1970
Vesey-Fitzgerald 1942a
Vinson 1936
Webb 1960b
Wiseman 1936

Seychelles group, Platte Island, Seychelles and Swift Banks

Acosta 1578
Adams 1868
Ahl 1934
"A.J." 1868-1870
Alluaud 1893, 1894, 1897, 1898a, 1898b, 1916
Alston 1925
Anastas 1897
Anderson, James F. 1879
Anderson, John 1878
André 1891
--- et al. 1871
Anon. 1816, 1840, 1861, 1865a, 1865b, 1883, 1888a, 1888b, 1892, 1894, 1897, 1898b, 1898c, 1905a, 1906b, 1907, 1908, 1912, 1914a, 1914b, 1916, 1917, 1918, 1919a, 1919b, 1920a, 1920b, 1920c, 1921a, 1921b, 1922a, 1922b, 1923, 1924a, 1924b, 1924c, 1924d, 1926, 1927a, 1927b, 1928, 1929, 1931, 1932, 1934, 1935, 1943, 1961d, 1962a, 1963, 1966, 1964d, 1966, 1968, 1970
Arnell 1957
Arrow 1922
Attems 1900
Atwood 1942

Auchinleck 1921a, 1921b, 1922a, 1922b, 1922c, 1922d, 1922e, 1922f, 1922g, 1922h
Aurivillius 1922
Bacon 1943
Bagnall 1921
Bailey, D. 1944, 1962
Bailey, L.H. 1930, 1942
Baker, B.H. et al. 1963
Baker, J.G. 1874, 1875, 1877
Balfour 1877a, 1877b
Ballard 1966
Balle 1964
Balss 1933
Banks 1840
Barclays Bank 1971
Barkly, Fanny A. [1897]
Barkly, Sir H. et al. 1864
Barnacle 1962, 1967
Barnard, K.H. 1964
Barnes, H.F. 1939
Bates 1951
Bauer 1897a, 1897b, 1898
Bauhin et al. 1619
Beamish 1968b, 1968c, 1969, 1970
Beier 1940
Belcher 1843
Belling 1971
Benedict 1963, 1966, 1967
Benson 1970f
--- et al. 1967
Berger 1962
Bergroth 1892
Beringer 1892
Berio 1962
Berlioz 1946, 1960
Betts 1940
Bigot 1962
Blackburn 1878
Blackman 1965, 1968
--- ed. 1966
--- et al. 1967
--- et al. [1968]
Blackwall et al. 1876
Blake et al. 1942
Blanc 1971
Blatter 1910, 1926
Bleeker 1868-1877
Boettger 1896
Bojer 1841
Bolivar 1894, 1924a, 1924b
--- et al. 1912
Bonâme 1909
Bonnetard 1921
Bory de St. Vincent 1804
Boschma 1948, 1957, 1959
Boughton 1970
Bouillon 1967, 1968
Boulenger 1911, 1915
Boullé 1902
Boulton 1960
Bouton 1857b, 1872
Bouvier 1893, 1913
Bowin 1964b
--- et al. 1965
Bradley 1928, 1930, 1936
Bradshaw 1954
Braithwaite 1970
Brandis 1894
Brauer 1896, 1897, 1898
Brazell 1956
Britten, J. 1886
Brölemann 1895
Brooks, C.E.P. 1919
--- et al. 1932
Brown, E.G. 1955
Brown, E.S. 1953, 1954a, 1954b, 1956
Bruce, A.J. 1966, 1967, 1968
Brunet 1894
Burgess et al. 1961
Burnell 1886
Byrne 1925
Caldwell, Elsie N. 1945
Calvert 1898
Cambridge 1876
Campbell 1970
Candèze 1895
Carcasson 1963
Cardot 1904
"Caret" 1934
Carlquist 1965
Carpenter 1916
Carvalho 1930-1932
Chabanaud 1955
Champion 1917, 1923
Charton 1854
Chavan 1946
Cherler 1619
Chevreux 1901
"Ch.G." 1876

Child 1965
Christianson 1912, 1942
Christensen 1912
Clark, G. 1864
Clarke, C.B. 1908
Clough ed. 1929-1933, 1930
Clutius (Cluyt) 1634
Cole, R.S. 1968
Collin 1911a, 1911b, 1922
Commerson et al. 1766-1769
Committee on Investigations in the Indian Ocean ["Murray Committee"] 1908, 1909
Connolly 1925
Cooke 1958
Corne 1969
Corner 1966
Coutière 1908
Craig 1963
Crépin 1865-1867
Crook 1960, 1961, 1964
Dalechamps 1587
Daly 1934
Dance, P. 1966
Dance, S.F. 1964
Darwin 1839, 1872
Dautzenberg 1893
D'Avézac et al. 1848
Davidson 1910
Davies 1964c
--- et al. 1964
Davis 1918
Dawson 1965, 1966a, 1966b, 1968
Dayer 1962, 1967
"D.C." 1801
De Berneaud 1836
De Bormans 1894
De Céré 1788
De Froberville 1845, 1848
De Gaye 1904
De Grandpré 1886, 1888a, 1888b, 1889
De Joannis 1893a, 1893b, 1899, 1915
De Jussieu 1789
De Labillardière 1801
De Laroche 1874
De Malavois 1787a, 1787b, 1787c, 1787d, 1787e
De Martius 1840
De Meillon 1953
De Orta (Ab Horto) 1563
De Quincy 1801
De Saussure et al. 1902
De Sélys-Longchamps 1869a, 1869b
De Sornay 1950
De Tchihatcheff 1878
De la Varde 1957
De Witte et al. 1943
Decary 1953
Degrandpré 1801
Delacour 1929, 1944
Deleuze 1807
Des Avanchers 1857
Devereux 1869
Deyrolle 1876
Diakonoff 1961, 1969, 1970
Diels 1922
Distant 1912a, 1912b
Dixon, H.N. 1929
Dollfus 1893
Dufo 1840
Dumont-d'Urville 1834
Dunnat 1850
Dupon 1971
Dupont, P.R. 1903, 1906, 1913a, 1913b, 1914, 1915, 1918, 1920, 1922a, 1922b, 1924b, 1924c, 1924d, 1924e, 1925b, 1925c, 1926a, 1926b, 1926c, 1926d, 1926e, 1926g, 1926h, 1926i, 1926j, 1926k, 1926l, 1927a, 1927b, 1927d, 1927e, 1927f, 1927g, 1928b, 1929b, 1930, 1931, 1934a, 1934b, 1934d, 1934e, 1934f, 1935a, 1935b, 1936, 1937a, 1939
East Africa High Commission: Meteorological Department monthly 1937-1951, [n.d.], 1942-1946, [n.d.], 1946, 1947, 1947-1948, [n.d.], annual 1949-, [1950], 1951-1955, 1952-1955, [1956], 1961, monthly -1963, 1964
East African Common Services Organization 1961
East African Meteorological Department annual, annual, annual 1955
Edbon 1968
Edmondson 1923
Edwards, Ada 1893

Edwards, F.W. 1941
Elgood 1961
Elizabeth 1970, 1971
Elkington 1929, 1930
Emboden 1970
Emery 1894
Enderlein 1929a, 1929b
Endrody-Younga 1963
Engel, A.E.J. 1963
Engel, Celèste G. 1963
Engler 1882
Esben-Petersen 1927
Estridge 1885
Evans 1924
Evans 1952
Fabricius 1902
Fairchild 1898
Fairmaire 1891a, 1891b, 1891c, 1892, 1893, 1895a, 1895b
Farmer 1955
Farquhar 1900
Faulkner 1959
Fauval, Albert 1898
Fauval, A.A. 1891, 1900a, 1900b, 1906, 1909, 1915
Fauvel, P. 1915
Fayon 1968, 1971
Ferrière 1912
Fletcher 1910
Fleutiaux 1903
Fock-Heng 1965
Forel 1897, 1907, 1912
Foster et al. 1943
Francis, K.A. 1940
Francis, T.J.G. 1964
Frankel et al. 1964
Frappa 1948
Frappaz 1820, 1824a, 1824b, 1824c
Frazer-Brunner 1933, 1950
Frénette 1963
Fressanges 1890
Fryer 1908, 1909d, 1911
Gadow et al. 1907
Gahan 1908
Galbraith 1898
Gardiner, J.S. 1901, 1903, 1905b, 1906b, 1907a, 1907c, 1908b, 1909
--- et al. 1908, 1909
--- et al. 1909
Gardiner, W. 1883
Gaskell 1954
Gaskill 1961
"Gates" 1966
Gay 1875
Gaymer 1965, 1966a, 1966b, 1967c
--- et al. 1968
--- et al. 1965
Germain 1920, 1924, 1934
Gervais 1836-1847
Gibson, H.S. 1938
Gibson-Hill 1950b
Giglio-Tos 1894
Giles 1945
Gillot 1779
Gomy 1969
Good 1951
Goodman 1964
Gordon, A.H., Lord 1894
Gordon, C.G. 1881
Grandidier et al. 1845-1902
Great Britain: Air Ministry: Meteorological Office 1932, [n.d.], 1940-1943
Great Britain: Central Office of Information 1958, 1964
Great Britain: Colonial Office annual 1886-1888, 1889-1890, 1891 etc., 1954
Great Britain: Foreign and Commonwealth Office annual 1969→ biennial
Great Britain: Secretary of State for the Colonies 1951
Great Britain: Secretary of State for Foreign Affairs 1966b
Greathead 1971
Green, E.E. 1907, 1910, 1913, 1916
--- et al. 1921
Green, M.L. 1933
Greenway 1958
Greffrath 1889
Griveaud 1960, 1970
Grossin 1742-1744
Grouvelle 1894, 1917
Gudger 1929, 1932
Guérard 1891
Guérin 1940, 1952
Guichenot 1865

Günther 1866, 1869, 1874
Hampson 1907, 1908
Hanchett 1969
Hardaker 1966
Harding 1913
Harper 1947
Harris 1964, 1966
Harrison 1837
Hartlaub, Carl J.G. 1861, 1877
Hartmann 1886
Hartog 1879
Hawtrey 1928
Hemsley 1884, 1885, 1907a, 1907b, 1916a, 1916b
--- et al. 1917
Henshaw 1914
Herbulot 1962a
Hermitte 1946
Herscher et al. 1911
Hillenius 1959
Hinds 1844
Hirth 1967
Hoffmann 1868-1877
Holdhaus 1929
Holdsworth-Haines 1934, 1935
Holland 1896
Hollyman 1964
Holman 1834
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Western Indian Ocean and islands: general, including Fortune and Saya de Malha Banks

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Gephyrea

Fischer, W. 1916a, 1916b

Annelida

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Monro 1937
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Sims, R. 1971

Myriapoda

Attems 1900, 1910
Brölemann 1895
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Nye 1960
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Seno 1965
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Carpenter 1916

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Eaton 1913b

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Calvert 1898
Campion 1913
De Sélys-Longchamps 1869a, 1869b
Laidlaw 1907
Martin, R. 1894, 1896
Pinhey 1967
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Holmgren 1906
Scott, H. 1932a
Snell et al. 1920
Tams 1920
Wasmann 1897

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De Saussure 1899
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Joly 1871, 1874
Vinson 1968

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Burr 1910
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Psocoptera (Copeognatha)

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Phthiraptera

Scott, H. 1914

Thysanoptera

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Bergroth 1892
Distant 1908, 1912a, 1913, 1916
Dupont, P.R. 1926a, 1927f, 1929a
Green, E.E. 1907, 1910, 1913, 1916
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Herring 1958
Hutchinson 1927
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Lambrecht 1970a
Maa 1970
Mamet 1936, 1941, 1943, 1954b, 1957
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Champion 1914, 1917, 1923
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Fauvel, Albert 1898
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Bernardi 1959, 1968
Bigot 1962
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Butler 1884
Carcasson 1963
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Diakonoff 1961, 1969, 1970

Fletcher 1909, 1910
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Griveaud 1960, 1970
Hampson 1907, 1908
Herbulot 1962a, 1962b
Holland 1895
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Jordan 1939
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Lionnet, J.F.G. 1970c
Meyrick 1910, 1911, 1923
Oberthür 1879
Poulton 1923
Ragonot 1893
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Viette 1968, 1962, 1963, 1970
Vinson 1938

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Barnes, H.F. 1939
Bezzi 1923
Brown, E.S. 1956
Collin 1911a, 1911b, 1922
De Meillon 1953
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Edwards, F.W. 1912, 1913, 1941
Enderlein 1910b, 1914
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Freeman et al. 1953
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Lamb 1912, 1914, 1921
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Matthew 1932
Mattingly et al. 1956
Scott, H. 1914, 1923, 1925a
Van Someren 1947
Stein 1910
Theobald 1901-1910, 1911

Siphonaptera (Aphaniptera)

Scott, H. 1914

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Brauer 1897
Cameron 1907
Cockerell 1911
Dupont, P.R. 1914, 1915, 1937a
Emery 1894
Forel 1897, 1907, 1912
Frappa 1937
Friese 1900
Kieffer 1910, 1911c, 1917
Mamet 1954a
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Turner, R.E. 1911
Vesey-Fitzgerald 1950

Crustacea: general

Edmondson 1923
Farrow 1970
Hilgendorf 1869
Hoffmann 1868-1877
Miers 1884
Pollen et al. 1868-1877
Ward, M. 1942b

Copepoda

Grice et al. 1967
Hulsemann 1967
Jones, E.C. 1966a, 1966b
Lehnhofer 1925, 1926, 1929
Mullin 1966
Rosendorn 1917
Schmaus et al. 1926
Sewell 1940, 1947, 1948, 1949, 1951
Steuer 1904, 1905, 1926, 1932, 1933
Vinogradov et al. 1961
Voronina 1961a
Wright, E.P. 1874

Cirripedia

Gruvel 1908
Newman, W.A. 1967
Nilsson-Cantell 1929, 1938
Smith, W.A. 1971
Southward 1967

Ostracoda

Cannon 1940
McKenzie 1969a
Müller, G.W. 1898, 1905
Poulsen 1962

Peracarida

Bernard, J.L. 1961
Barnard, K.H. 1937, 1964
Behning 1914
--- et al. 1912
Budde-Lund 1912
Chevreux 1901
Dollfus 1893
Fage 1941-1942, 1960
Gerstaecker 1873
Illig 1906, 1906-1913, 1930
Paulian 1959
Schellenberg 1926
Schoenichen 1908
Stebbing 1909
Tattersall 1911, 1939
Vinson 1946
Wagler 1922
Walker, A.O. 1908, 1909
Woltereck 1912

Hoplocarida (Stomatopoda)

Borradaile 1907b
Foxon 1939
Jurich 1904
Lenz 1905, 1910
Manning 1962

Eucarida

Andrews 1909
Balss 1911, 1913, 1914, 1920, 1926, 1933
Borradaile 1907a, 1909, 1910, 1915, 1916a, 1916b
Bouvier 1893, 1913
Bruce, A.J. 1966, 1967, 1968, 1969a, 1969b
Calman 1939
Coutière 1908, 1918
Doflein 1903
--- et al. 1913
Grubb 1969b
Guinot 1964
Harris 1964
Illig 1906, 1906-1913, 1908, 1926, 1930
Kemp 1913
King, P.P. et al. 1839
Laurie 1925
Lenz 1905, 1910
Milne-Edwards et al. 1893
Ortmann 1902
Rathbun 1894, 1911
Reyne 1938
Richters 1880
Smith, J.L.B. 1965, 1968
Tattersall 1911, 1939
Taylor, J.D. 1971c
Tirmizi 1959
Ward, M. 1942a

Arachnida

Beier 1940
Blackwell et al. 1876
Bonnet 1945
Cambridge 1876
Gerstaecker 1873
Hirst 1911, 1913
Loman 1902
Neumann, L.G. 1907
Pocock 1904
Simon, E. 1864, 1893, 1897, 1901a, 1901b
Strand 1907, 1915
Vinson 1946, 1949
Warburton 1912

Pycnogonida

Calman 1938
Carpenter 1907
Fage 1956
Möbius 1902

Chaetognatha

Alvariño 1964
Burfield et al. 1925
Harvey 1925
Tokioka 1962

Echinodermata

Bell 1884, 1908
Brock 1888
Campbell 1970
Clark, A.H. 1937
Clark, A.M. et al. 1971
Clark, H.L. 1939
De Loriol 1883-1893
Döderlein 1906, 1911
Hartlaub, Clemens 1891
Heding 1939
Hertz 1927
Hoffmann 1868-1877
Koehler 1897, 1898
Ludwig 1898
Madsen 1951
Von Martens 1870
Mortensen 1939
Ormond et al. 1970
Perrier 1869, 1875-1876
Pollen et al. 1868-1877
Taylor, J.D. 1971b

Urochordata

Apstein 1905
Hartmeyer 1912
Lohmann 1930
Michaelsen 1918, 1919a, 1919b, 1920
Millar 1957-1959
Neumann, G. 1905, 1912
Sewell 1953

Cephalochordata

Gibson, H.O.S. 1909
Goldschmidt 1905

Vertebrata: general

Lowery 1969

Fishes

Alexander, E.C. 1961
Ankaru 1959
Anon. 1959a
Arnoult et al. 1958
Badcock 1970
Baissac 1962
Bauchot-Boutin 1958
Bauchot 1959
Bertelsen 1951
--- et al. 1956
Bertin 1934, 1937, 1938
Bleeker 1868-1877
Bogorov et al. 1960
Boulenger 1908
Brauer 1902, 1906
Chabanaud 1955
Cole, R.S. 1968
Collette et al. 1971
Cushing 1969
De Falla 1965
Diolé 1971
Dupont, P.R. 1926c, 1935b,
--- et al. 1928
Ege 1934, 1938, 1948,
1953, 1957, 1958
Forster et al. 1970
Fraser-Brunner 1933, 1940,
1950
Gibbs 1963
--- et al. 1967
Gorbunova 1963
Grage 1967
Grey 1955
Gudger 1929, 1932, 1934
Guichenot 1865
Günther 1866, 1869
Hirano et al. 1956
Hiyama 1958, 1959
Hornell 1927a
Howarth 1961
Hurwitz 1967
India: Central Marine
Fisheries Research
Institute 1968
Jatzow et al. 1898
Jespersen 1942
Jones, S. 1962
--- et al. 1962
--- et al. 1962
Kataoka 1957
Koga 1958a, 1958b
Kumaran 1962
Kurogane et al. 1958, 1959
Lenz 1898
Longbottom 1970
Losse 1968
Lunel 1881
Marshall 1956
Von Martens 1869a
Mead et al. 1965
Merrett 1967, 1970
Mimura 1955, 1958, 1962
Möbius et al. 1878
Mohr 1937
Morrow 1959, 1962
Myers 1933
Nakagome 1958, 1962
Nakamura et al. 1955
Norman 1939
Nybelin 1957
Ommanney 1953b, 1965
Ozawa 1965
--- et al. 1965
Panikkar 1966
Parr 1960
Pellegrin 1922, 1932, 1933
Peters, W. 1876, 1878
Playfair 1867
--- et al. 1866
Plomley 1968
Pollen et al. 1868-1877
Potts, G.W. 1969, 1970
Rass 1960
Regan 1907, 1912
--- et al. 1932
Rofen 1957-1959
Roux-Estève 1958
Seno 1965
Silas 1962a, 1962b
Smith, J.L.B. 1955a, 1955b,
1955c, 1955-1958, 1956a,
1956b, 1956c, 1956d, 1956e,
1956f, 1957a, 1957b, 1957c,
1957d, 1957e, 1958a, 1958b,
1958c, 1958d, 1959a, 1959b,
1959c, 1959d, 1959e, 1960,
1961a, 1961b, 1962a, 1962b,
1962c, 1962d, 1963a, 1963b,
1964, 1965, 1968

--- et al. 1963
Smith, Margaret M. 1963
Tagawa 1956
Thomson, K.S. 1970
Travis 1961
Trewavas 1932
Tyler 1966a, 1966b, 1966c, 1967
Uda 1965b
Ueda et al. 1965
Ueyanagi 1962
Ward, B. 1962
Ward, S. 1869
Weed et al. 1961
Wheeler 1946, 1950, 1959, 1960, 1961
--- et al. 1953
Williams, F. 1958
Wright, E.P. 1870b
Yabuta 1955
Yamanaka et al. 1959

Amphibia

Ahl 1934
Boettger 1896
Boulenger 1908, 1911
Brauer 1898
Gaymer 1967c
Honegger 1966c
Lawson 1963, 1965a, 1965b, 1965c, 1966
Macarthur et al. 1967
Nieden 1913
Noble 1926
Parker, H.W. 1936, 1941, 1947, 1958
Peters, W. 1877
Peters, W.C.H. 1869
Schilling 1935
Stejneger 1893
Taylor, E.H. 1968
Vesey-Fitzgerald 1947
Wilson, E.O. 1967

Reptilia

Angel 1950
Anon. 1964d
Beltz 1953, 1954, 1958, 1960
Blanc 1971
Boettger 1896, 1913
Boulenger 1908, 1911, 1915
Burton 1967
Carié 1925
Carr 1970
Cherbonnier 1964
Davidson 1910
De Malavois 1787e
De Witte et al. 1943
Elizabeth 1971
Fauvel, A.A. 1900a
Frazier 1971
Frere 1874
Friedel 1896
Gadow 1892
Gaymer 1966a, 1966b, 1967a, 1967c, 1967e
Grossin 1742-1744
Grubb 1969a
Günther 1874, 1877, 1884
Haddon 1879
Harrison 1969
Heck 1957
Hillenius 1959
Hirth 1967
--- et al. 1970
Holloway et al. 1969
Honegger 1966a, 1966c, 1966d, 1968
Hooker, Sir J.D. et al. 1874
Hornell 1927b
Kirk 1874
Laidlaw 1902
Laurent, R. 1943
Laurent, R.F. 1965
Loveridge 1942

--- et al. 1957
Mertens 1934, 1966
Moine 1963
Newman, K.B. 1965b
Newton, A. 1874
Owen, Sir R. 1874
Palombelli 1954
Parker, H.W. 1936
Parsons, J.J. 1962
Peters, W. 1877
Picault 1742-1744
"R.E." 1878
Rendahl 1939
Rothschild 1897, 1906, 1915, 1928
Sauvage, E. 1875
Sauzier 1892, 1893, 1895, 1899
Schacht 1902
Siebenrock 1902, 1903, 1906, 1909
Smith, M. 1935
Stejneger 1893
Street 1960
Travis 1959
United Nations Organization: Food and Agricultural Organization 1967
Vaillant 1899, 1903
Veevers-Carter, M. 1962
Vesey-Fitzgerald 1947
Voeltzkow 1896
Wheeler 1953
Williams, E.E. 1952, 1954

Aves

Alexander, W.B. 1928
Bailey, R.S. 1963, 1964, 1965, 1966a, 1966b, 1967
--- et al. 1966
Beamish 1968c
Bendire 1894
Benson 1960a, 1960b, 1962, 1967, 1968, 1969, 1970a, 1970b, 1970c, 1970e, 1970f, 1970g
--- et al. 1968, 1960
--- et al. 1967
Von Berlepsch 1898
Berlioz 1946, 1960
Betts 1940
Blackburn 1878
Blackman 1968
Blasius 1887
Boulton 1960
Bourne, W.R.P. 1959, 1960, 1962, 1963, 1965, 1966, 1969, 1970a, 1970b, 1971
Bowdler-Sharpe 1884
Cabanis 1869
Cheke 1966
Clancey 1958, 1968
Crook 1960, 1961, 1964
Dawson 1965, 1966a, 1966b, 1968
Delacour 1929, 1964
Diamond 1969a, 1969b
Dixon, C. 1898
Dupont, P.R. 1907, 19261, 1930, 1937b
Edinburgh et al. 1970
Elkington 1929, 1930
Farquhar 1900
Fayon 1968, 1971
Finsch 1887
--- et al. 1887
Fisher, J.M.M. 1970
Gadow et al. 1907
Gardiner, J.S. 1907c
Gaymer 1965, 1966a, 1967b
--- et al. 1968
Gibson-Hill 1948, 1950a, 1950b, 1952
Gill 1967
Goodwin 1967
Grant, C.H.B. et al. 1933
Grant, P.R. 1965
Greenway 1958
Griffiths 1969
Guérin 1940, 1952
Günther 1879
Hartlaub, Carl J.G. 1860, 1861, 1877
Hartman 1958
Henshaw 1914
Honegger 1966b

Hutchinson 1950
Jouanin 1957
Koenig 1940
Lapthorn et al. 1969
Legrand 1964a, 1964b
Lionnet, J.F.G. 1971e
Loustau-Lalanne 1961a, 1961b,
1962a, 1962b, 1963a, 1963b,
1968
Lowe 1924
McConville 1967
Mackworth-Praed 1933
Mayr et al. 1948
Meade-Waldo 1907, 1908
Mees 1957, 1961
Milne-Edwards et al. 1885
Moreau, R.E. 1937, 1957, 1960a,
1960b, 1966
Morris 1963
Newman, K.B. 1965a, 1965b
Newman, T.H. 1908
Newton, A. 1865, 1876, 1879
--- et al. 1876
Newton, Sir E. 1867a, 1867b, 1888
Nicoll 1906a, 1906b
Oustalet 1877, 1878, 1885
Ozawa et al. 1965
Palombelli 1954
Parker, I.S.C. 1970
Paulian 1959
Pelte 1952
Penny, C. Mary 1968
Penny, M.J. 1965a, 1965b, 1965c,
1965d, 1968a, 1968b, 1968c,
1968d, 1969a, 1969b
--- et al. 1969
Percy 1958, 1966
Philip et al. 1970
Pocklington 1965, 1966, 1967
Pollen et al. 1868-1877
Rand 1936
Reichenow 1900, 1904
Renshaw 1939
Ridgway 1893, 1894a, 1894b, 1895
Ridley, M.W. 1956, 1957, 1960,
1961, 1968
--- et al. 1958, 1966
Ripley 1968, 1971
Rothschild 1907
Rountree et al. 1952
Roux 1967
Salomonsen 1933
Saunders 1886
Schlegel 1868-1877
Sclater, P.L. 1871
Sclater, W.L. 1912
Seno 1965
Sharpe, R.B. 1884
Shelley 1896-1912
Shuntov 1967
Sims, R.W. 1960
Snouckaert van Schauburg 1935
Stoddart, D.R. et al. 1970
Storer 1963
Tristram 1880
Vanhöffen 1901
Vaurie 1948, 1949, 1963
Vesey-Fitzgerald 1936, 1940d,
1953
--- et al. 1940
Vinson 1949, 1952
Voous 1966
Warham 1964, 1966
Watson, G.E. et al. 1963
White, 1950
Williams, J.G. 1952, 1953
Willis, P.R. 1966
Zusi 1963

Mammalia

Anon. 1859
Boschma 1951
Brown, S.G. 1957
Bullen 1898
Gervais 1848-1852
Gray 1870-1871
Hill, J.E. 1969
Lionnet, J.F.G. 1971e
Von Lorenz-Liburnau 1898
Miller, G.S. 1902
Milne-Edwards et al. 1885
Oustalet 1885
Peters, W. 1868
Peters, W.C.H. 1869

Sclater, P.L. 1899
Sclater, W.L. et al. 1899
Thomas, O. 1915
Townsend, C.H. 1931, 1935
True 1893, 1894
Wright, E.P. 1868b

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Nos. 166-170 November 23, 1973

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ATOLL RESEARCH BULLETIN

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by R. Endean and W. Stablum

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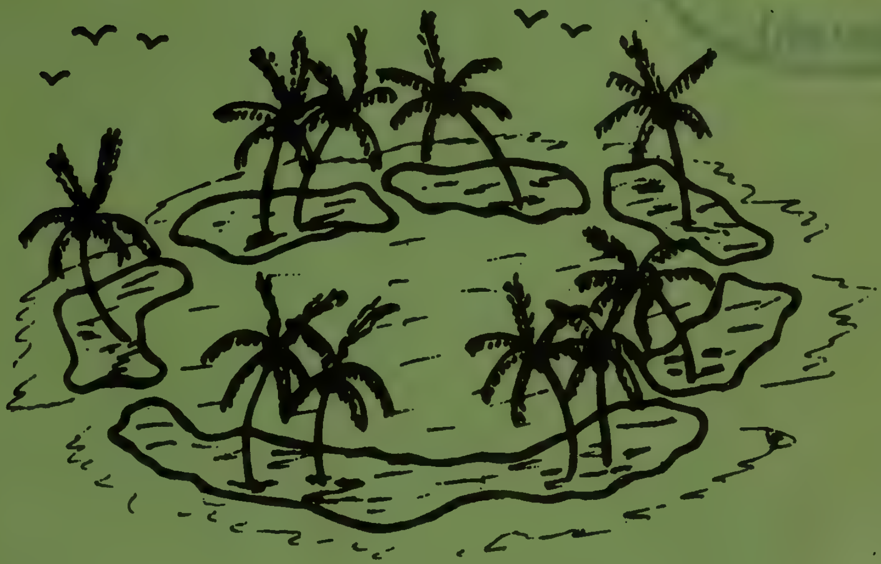
by Dennis M. Devaney and John E. Randall

170. *Population levels of Acanthaster planci in the Mariana and Caroline Islands 1969-1972*
by James A. Marsh, Jr. and Roy T. Tsuda



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CROWN OF THORNS (ACANTHASTER PLANCI) PLAGUES: THE NATURAL CAUSES THEORY

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Contents

	Page
Abstract	1
Introduction	1
Observations	2
Discussion	3
Conclusions	7
Acknowledgements	7
References	8

Figures (following p. 10)

1 *Acanthaster planci* removed from hiding and placed in light during daytime soon moves back into shaded conditions. The long light-sensitive terminal podia can be seen.

2 Peter Goreau (son of the late Tom Goreau) studies an *Acropora* table in the Red Sea. The white region has been predated upon by *A. planci* and the peripheral darker region is still alive. Twelve *A. planci* were found under the table, mostly attached to the basal stem.

3 *A. planci* moving over sand.

4 Two *A. planci* revealed by removing an overlying slab of coral.

CROWN OF THORNS (ACANTHASTER PLANCI) PLAGUES: THE NATURAL CAUSES THEORY

by Peter J. Vine[1]

ABSTRACT

The history of research on Acanthaster planci prior to 1960 is briefly reviewed and the results of some more recent research are discussed. There is evidence that many "plagues" of A. planci have occurred prior to 1960. Predation by Charonia tritonis on A. planci is unlikely to have been a significant factor controlling its population in any area. The suggestion that artificial damage to coral reefs, by blasting or dredging, has created conditions for population explosions of A. planci is considered in relation to the known habits of larval and juvenile stages. It is suggested that many "plagues" have been aggregations which are a natural and necessary facet of the life of this species. There is some evidence that feeding starfish release a chemical attractant thus producing mini-aggregations. The likely results of destruction of corals by A. planci are briefly discussed and a possible measure to reduce populations is suggested.

INTRODUCTION

The crown-of-thorns starfish, Acanthaster planci, was known to science long before the recent focus of public attention on destruction of coral reefs which it is causing in the Indo-Pacific. Rumphius mentioned it in 1705 and it was described by Plancus and Gualtieri in 1743. The name Acanthaster planci was created by Linnaeus in 1758. Early knowledge of its widespread distribution can be gathered from the literature; Goa (Portuguese India), 1743; Java, 1793; Philippines, 1781; and Mauritius, 1885. It was recorded from Australia's Great Barrier Reef in 1913 (Clark, 1921) and at Low Isles, where the Great Barrier Reef Expedition was centred in 1928-29 (Livingstone, 1932). Other records such as those of Madsen (1955) indicate a widespread distribution throughout the Indo-Pacific. It has not been recorded from the Caribbean.

---

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(Manuscript received June, 1971--Ed.)

OBSERVATIONS

Early records of large aggregations of A. planci are understandably scarce. The animal prefers a sublittoral habitat and is frequently hidden during the day. Many reef areas were seldom visited and very rarely dived upon. Indigenous people on atolls throughout the Indo-Pacific recognise the starfish, have remedies for stings caused by penetration of its spines, and in some cases are able to report large numbers which have appeared on their reefs in the past. Mortensen, who studied A. planci in the Java Sea in 1929, wrote in 1931: "This species was found rather commonly on the coral reefs at the little island of Haarlem off Batavia, near Onrust......". It was also reported as "common" in Port Galera Bay and Sabang Cove in the Philippines in 1938 (Domantay and Roxas, 1938), as "very common" in the Palaus (Hayashi, 1938) and "abundant" around Christmas Island (Edmonson, 1946). As Dana (1970) has pointed out it seems quite probable that these records might have been applied to the modest densities which are now said to constitute plagues (Endean, 1969; Pearson, 1970). I have spoken to fishermen in the Solomon Islands who recall large concentrations of them many years ago. It was said of Maringe lagoon, Santa Ysabel, that night-time fishing on the reef was especially hazardous about 40 years ago, because fishermen were afraid of treading on starfish which were present in large numbers. It has been widely held that Green Island experienced the first "plague" on the Great Barrier Reef in 1959 (Endean, 1969) but an experienced professional diver from Townsville, D. Tarca (personal communication and Sunday Mail, September 7, 1969) recalled that there were large numbers on the south-east side of Lodestone reef in 1954.

Attention was drawn to the feeding habits of A. planci by Goreau (1963) who discovered an aggregation in the southern Red Sea. He foresaw the likelihood that: "this species may, under certain conditions, be an important factor limiting the growth and development of coral reefs". At that time large numbers of A. planci were being reported from reefs near Cairns, on Australia's Great Barrier Reef, and destruction of corals had been noticed at the tourist resort of Green Island.

Pearson, the scientist employed by the Queensland Government to investigate the biology of Acanthaster and the damage which it was causing on the reef, reported further recent and massive destruction of corals in the Innisfail area, which had gone quite unnoticed by the press and public. This suggests that intense destruction of coral by A. planci may have occurred undetected throughout the range of the species many times in the past.

Recent research by Pearson and Endean in Australia, Chesher and a team of scientists at Guam and elsewhere in the

Pacific, Weber and Woodhead in the Pacific, the Cambridge Coral Starfish Expedition in the Red Sea and a large number of individual scientists, who have reported on its distribution, have added greatly to our knowledge of this species (see papers by Barnes, 1966; Branham et al, 1971; Chesher, 1969 and 1970; Dana, 1970; Dana and Wolfson, 1970; Elderedge, 1970; Roads and Ormond, 1971; Vine, 1970; Weber and Woodhead, 1970).

Endean (1969) suggested that removal by shell collectors of the giant triton, Charonia tritonis, which preys upon A. planci, may have removed the predator pressure controlling populations of this starfish. He believed that the larvae had a short planktonic life: "a matter of a few days", and that significant pressure could be exerted on the population by C. tritonis. Mortensen (1931), however, had shown that the larval development of A. planci takes two to three weeks. He succeeded in fertilising eggs and reared the larvae for sixteen days, by which time they had reached the brachiolaria stage. Recently Henderson and Lucas (1971) have shown larval life is 4-5 weeks, depending on temperature. Such animals normally produce great numbers of eggs and Pearson has estimated the egg production of a female Acanthaster of average size (30 cms.) to be 12-24 million. Thorson (1950) has shown how such invertebrates undergo great fluctuations in population size, depending on their breeding success and particularly the conditions met by their larvae in the plankton. Charonia tritonis is a somewhat scarce and sluggish predator. One was recorded as eating on average 0.7 Acanthaster per week when given an unlimited supply (Pearson and Endean, 1969). Experiments have indicated, moreover, that C. tritonis usually prefers to eat Linckia laevigata, a blue starfish which appears to be more abundant than A. planci on many coral reefs which I have visited in the Pacific (Vine, 1970).

Chesher (1969) suggested that A. planci larvae are heavily preyed upon by live coral polyps and that areas for safe settlement of larvae are severely restricted on a normal coral reef. He points out that mechanical damage to reefs, such as is caused by blasting or dredging, may have reduced predatory pressure on the larvae and increased the area suitable for settlement. Increased survival of larvae would produce localised dense populations of A. planci. These would increase the area of dead coral by their feeding activities and might thus further reduce predation on the larvae, simultaneously increasing the area suitable for subsequent settlement.

DISCUSSION

This suggestion, that recent mechanical damage may have been important, meets with the difficulty that coral reefs have long been subject to cyclone damage. Disturbance of coral by such a natural cause would presumably result in conditions similar to those postulated as favouring the development of *A. planci* plagues. Pearson (Pearson and Endean, 1969) has shown that larvae can in fact settle in areas of rich coral growth, especially among the basal stems of closely packed branching colonies of *Acropora echinata*. The larvae may indeed swim for a long time among the coral stems for it seems well established that echinoderm larvae can delay metamorphosis until they discover an area suitable for settlement (Mortensen, 1938). The older photonegative larvae (Thorsen, 1950) may thus be expected to visit the bottom repeatedly, while being carried by water currents for several days, but it is not clear that they would be vulnerable to predation by coral. If they are photonegative, it is probable that most of their searching is carried out during daylight, when the majority of coral polyps are not feeding. Shaded crevices of coral reefs offer many suitable surfaces, which are free from filter feeders and would provide for the attachment of brachiolaria larvae and the protection of young metamorphosed starfish. In most situations the coral cover of a flourishing reef is only 30-50 per cent (Talbot and Talbot, 1971) and the remainder is veneered with hard encrusting red coralline algae forming sheets or patches of cement-like pink calcium carbonate. Larvae reared in the laboratory settled in the presence of encrusting algae, algal detritus, serpulid tubes, fine siliceous sand, lithothamnion, live *Pocillopora damicornis*, spines and tube feet of *A. planci* and recently predated *P. damicornis* (Henderson and Lucas, 1971). Mechanical destruction of coral would seem to be unnecessary for survival and metamorphosis of *A. planci*, and might be unfavourable through reducing the available food. Moreover it does not necessarily follow that a "seed" population would reproduce locally and thus build up in the manner envisaged by Chesher, since the larvae have a planktotrophic life of considerable duration, during which they must be widely dispersed and are probably preyed upon heavily.

Several workers have recently suggested that the present situation regarding populations of *A. planci* is natural (Weber and Woodhead, 1970; Dana, 1970; Vine, 1970) and it appears likely that the recent outbreak of reports of "*A. planci*" reflects an increase in the number of divers aware of the starfish. There seems to be no need to postulate a real increase in the numbers of *A. planci* in the Indo-Pacific. As Pearson (1969) has pointed out, prior to 1964, starfish aggregations on the Great Barrier Reef had been overlooked by fishermen and skindivers. In the Red Sea I asked several fishermen, shell collectors and skindivers where we could find large numbers of *Acanthaster*. Nobody could direct us to a "plague", although we eventually discovered two reefs on which large numbers were found, both within several miles of Port Sudan (Roads and Ormond, 1971).

The fact that "plagues" have now been reported throughout the range of distribution of *A. planci* suggests that these are in fact natural facets of the life-history of Acanthaster. Work carried out by the Cambridge Coral Starfish Expedition in the Red Sea tends to support this view. Within the aggregations of A. planci which were discovered we identified "mini-aggregations"--many starfish huddled together, often with arms interlocked or discs partly overlapping, emerging at night time from their shaded situations under Acropora tables to feed together on the same tables. Although the majority were inactive and hidden in daytime, occasional individuals were observed moving over sandy areas between the hidden mini-aggregations. The presence of other A. planci did not appear to attract these moving starfish, but at night A. planci which had commenced feeding appeared to attract others. Thus the number feeding on a particular table increased, and it seems possible that some form of chemo-attraction may be exerted by feeding starfish. Research by Brauer, Jordan and Barnes (1970) suggests that A. planci may be attracted by particles of semi-digested coral tissue. They demonstrated reflex stomach eversion by injection of coral extract into the water. The degree of responsiveness of starfish to this stimulus was greater at night than during daytime. Chemo-attraction between individuals has not been conclusively demonstrated but seems likely to occur. Experiments carried out with Y tubes on A. planci in the Red Sea indicate that individuals are attracted to feeding starfish (R.F.G. Ormond, personal communication, October 1971). In a Red Sea area where Acanthaster was sparse, observed directions of movement of isolated individuals, in relation to the spacing of previous feeding scars, suggested the possibility that chemo-attraction from aggregations may attract starfish from one or two miles away. Thus massive aggregations may perhaps form by mechanisms similar to those which create mini aggregations.

The fact that feeding aggregations develop naturally suggests a mechanism by which massive sudden population increases may occur. A slight fluctuation in larval survival may result in an increased population density of starfish. Beyond a certain level a significant increase may occur in the number and size of feeding aggregations which develop. Greatly increased fertilisation within these aggregations could lead to a sudden increase in metamorphosed starfish. Thus the initial change in conditions may be quite small (giving rise to a slight increase in population). This triggers off a natural chain of events which may lead to sudden localised population explosions.

An advantage of aggregations is that they increase the chances of successful fertilisation of eggs. It is doubtful whether isolated individuals contribute at all to the planktonic population of larval A. planci (see Thorson, 1950). Epidemic spawning has been recorded in a number of asteroids: Asterias rubens (Gemmill, 1914; Bull, 1934); Asterias forbesi (Galstoff and Loosanoff, 1939); Solaster papposus (Gemmill, 1920); and Astropecten irregularis (Thorson, 1946). Pearson (Pearson and Endean, 1969) observed synchronous male spawning in A. planci and this seems to have triggered off spawning in at least one female a metre away from the nearest spawning male. Probably fertilisation is ensured through some ecto-hormone, as in Asterias (Chaet, 1961; Kantani et al, 1963; Stebbing, 1967), and the successful reproduction of A. planci may well rely upon the formation of aggregations.

A fortunate result of the aggregated feeding habits of A. planci is that the damage is localised and many large coral structures are left completely untouched. Where aggregations appear to have been abnormally large (such as at Guam and on a section of the Great Barrier Reef), there is less likelihood of any large coral structures remaining undamaged, except of those species not usually attacked by A. planci (see Pearson and Endean, 1969), but the majority of reported "plagues" have been of more moderate proportions. It is a characteristic feature of such areas that some coral structures survive undamaged. I have seen examples of this at Northeast Bay on Great Palm Island, where isolated outcrops of delicate staghorn Acropora remained untouched whereas at least 50% of the Acropora was killed (see also Endean, 1969; Pearson and Endean, 1969). Off Fiji and in the Red Sea I have observed similar examples. The corals which escape attack are likely to provide planulae for settlement and recolonisation of devastated areas. This is a slow process but it has been observed to occur (Pearson and Endean, 1969).

Suggestions that fishermen will lose their livelihoods, reefs will erode and atolls sink gradually beneath the waves must be treated with more than a little scepticism. Apart from destruction of corals, few faunistic changes in the ecology of reefs devastated by A. planci have been observed by Pearson and Endean. Pacific islanders appear to rely a great deal on bottom fishing from deep water off the edges of reefs, and from fishing for pelagic fish. Neither of these fish populations are likely to be affected by A. planci destruction. There has been little evidence of serious reef erosion following devastation by A. planci and indeed this seems unlikely to occur.

Cover by live corals on richly flourishing reefs is remarkably low (Talbot and Talbot, 1971) and many reefs consist mainly of dead coral material covered by calcareous algae. Indeed, this is a feature of areas most exposed to wave action, such as in shallow water on exposed sides of reefs. Rates of recolonisation and regrowth of coral appear more than enough to compensate for gradual sinking of some reefs. In view of the massive thickness of dead coral on most coral reefs, beneath the thin veneer which is alive, it is worth considering the possibility that, far from having a deleterious effect on the development of coral reefs, dense predation by A. planci may actually promote their development by killing protuberant colonies and thus encouraging firmer regrowth and cementation basally. As growth studies on scleractiniam corals have shown (Manton, 1932; Motoda, 1940; Abe, 1940) initial rapid growth rate of a colony, or individual in the case of Fungia, is followed by a slowing down, leading to almost complete cessation. Thus, by providing new surfaces for settlement of planulae and development and more rapid growth of young colonies, predation by A. planci may lead to an acceleration of reef growth.

CONCLUSIONS

Although predation on coral by A. planci may be a normal facet of the development of coral reefs, in the short view massive destruction of scleractinian corals is undesirable on reefs visited by tourists. The only practical solution so far suggested is to kill or remove Acanthaster from infested reefs (Endean, 1969). In view of the restricted breeding season of A. planci in several regions affected by plagues (Pearson and Endean, 1969) and the probability that recruitment takes place from aggregated stocks, where fertilisation is more likely to occur, it is suggested that efforts by skindivers to remove A. planci from reefs should be concentrated on aggregations in the period immediately prior to the breeding season. It is thus important to establish whether a regional population exhibits a restricted breeding season such as that reported by Pearson (1970) for A. planci on the Great Barrier Reef, and to discover the time of the main breeding period (December to January in Queensland waters). Given competent divers it would be considerably more efficient to collect starfish at night time when more are exposed on corals. Removal of aggregated starfish following the breeding season is unlikely to have a significant effect on the population in an area, whilst searching out and removing isolated individuals is probably never worth the effort.

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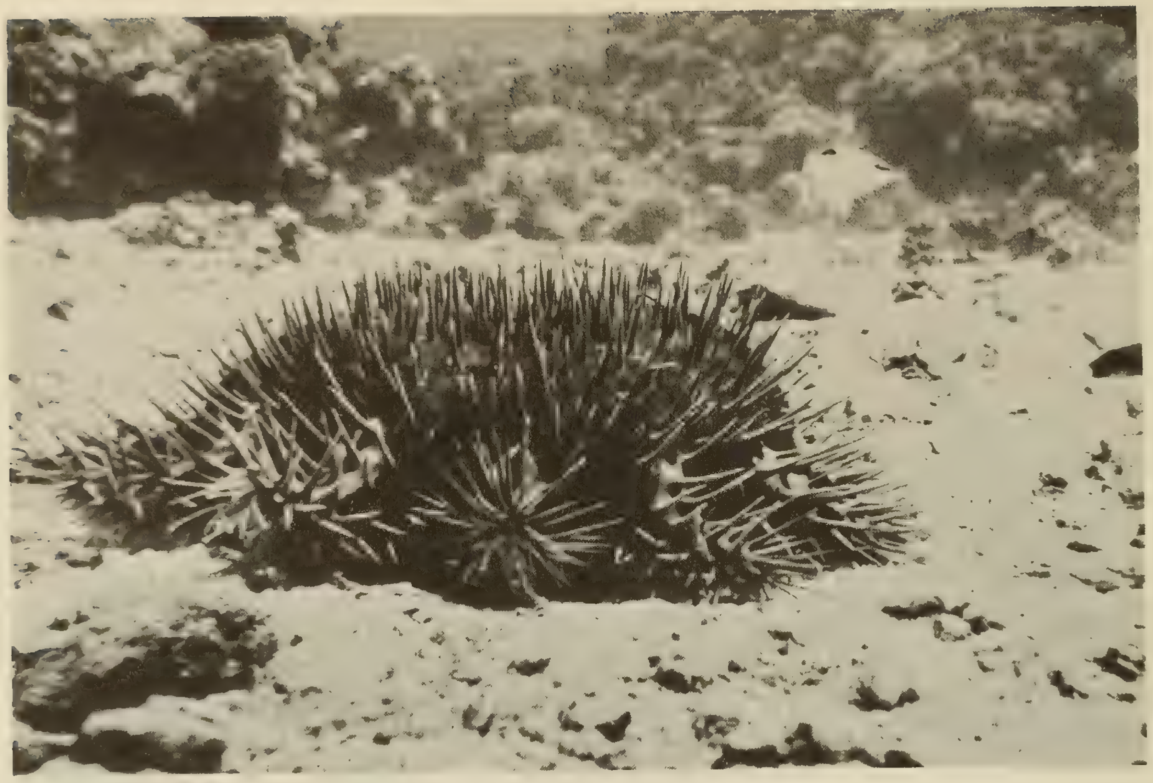
FIGURES

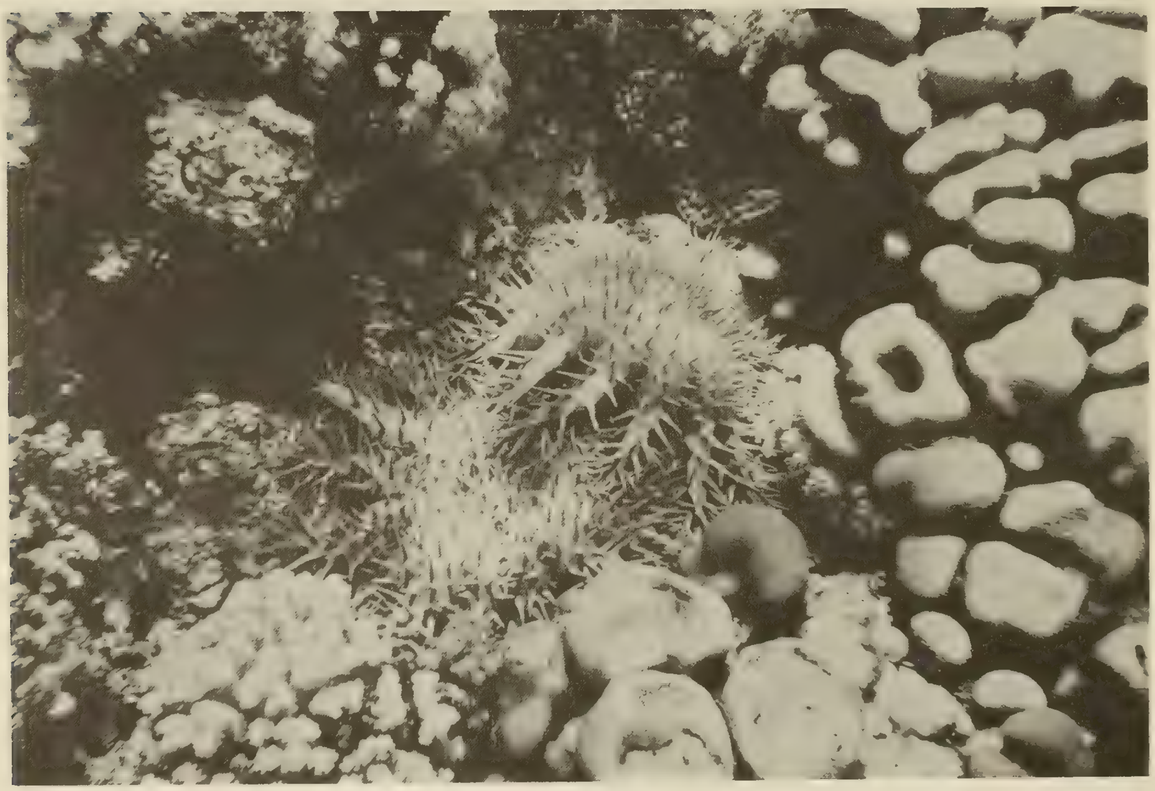
1 *Acanthaster planci* removed from hiding and placed in light during daytime soon moves back into shaded conditions. The long light-sensitive terminal podia can be seen.

2 Peter Goreau (son of the late Tom Goreau) studies an *Acropora* table in the Red Sea. The white region has been predated upon by *A. planci* and the peripheral darker region is still alive. Twelve *A. planci* were found under the table, mostly attached to the basal stem.

3 *A. planci* moving over sand.

4 Two *A. planci* revealed by removing an overlying slab of coral.





ATOLL RESEARCH BULLETIN

NO. 167

A STUDY OF SOME ASPECTS OF THE CROWN-OF-THORNS STARFISH (ACANTHASTER PLANCI) INFESTATIONS OF REEFS OF AUSTRALIA'S GREAT BARRIER REEF

by R. Endean and W. Stablum

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Contents

	Page
Abstract	1
Introduction	2
Materials and Methods	3
Results	6
Discussion	12
Acknowledgements	19
References	19

Figures (following p. 20)

1 Map of Queensland and the Great Barrier Reef. The shaded area represents the region of the Great Barrier Reef affected by the *A. planci* plagues.

2 Map of portion of the Great Barrier Reef showing the positions of some of the reefs visited during the present investigation. The positions of 8 reefs referred to in this paper but not visited during this investigation are also shown.

3 Map of portion of the Great Barrier Reef showing the positions of the remainder of the reefs visited during the present investigation.

4 Portion of back reef area west of sand cay at Beaver Reef illustrating sparse hard coral cover (December, 1970).

5 Portion of seaward slope on south-east side of Glow Reef illustrating moderate hard coral cover (January, 1971).

6 Portion of seaward slope on north-east side of Potter Reef illustrating dense hard coral cover (May, 1971).

7 Portion of seaward slope on east side of Coil Reef illustrating low damage to hard corals caused by *A. planci* (July, 1970).

8 Portion of seaward slope on west side of Trout Reef illustrating marked damage to hard corals caused by *A. planci*. A specimen of *A. planci* is visible near the centre of the photograph (December, 1969).

9 Portion of seaward slope on east side of John Brewer Reef illustrating heavy damage to hard corals caused by *A. planci* (January, 1971).

10 Living tabular acropores on reef crest on north side of Broadhurst Reef (October, 1970).

11 Skeletons of tabular acropores killed by *A. planci* on seaward slopes on north side of Broadhurst Reef (February, 1970).

12 Photograph of quadrat in position on seaward slope at northern tip of Lodestone Reef (July, 1970). Analysis of reef cover in quadrat yields 26.3% LHC, 37.3% DHC, 0% SC and 36.4% ADS.

13 Massed specimens of *A. planci* underlying part of a quadrat on the reef flat at Slashers No.1 Reef (August, 1970).

14 Soft coral cover on reef flat near sand cay at Taylor Reef (May, 1971).

15 Soft coral cover on reef flat near sand cay at Taylor Reef (May, 1971).

16 Large numbers of *A. planci* on hard corals on reef flat at Slashers No.1 Reef (August, 1970).

17 A colony of staghorn coral almost completely enveloped by a mass of feeding *A. planci* at Slashers No.1 Reef (August, 1970).

18 Graphs showing size frequencies of populations of *A. planci*.
- A. Population sample from reef crest at Slashers No.4 Reef on 27.1.71.
- B. Population sample from reef crest and seaward slope south east side of Glow Reef on 28.1.71. Specimens in the size range 70-120 mm were collected on the reef crest, the remainder from the reef slope.
- C. Population sample from a coral pinnacle in the back reef area at Nathan Reef on 26.9.69.
- D. Population sample from a coral pinnacle in the back reef area at Nathan Reef on 27.1.70.

19 Graphs showing size frequencies of populations of *A. planci*.
- A. Population sample from back reef area at Big Sand Cay Reef on 26.5.71.
- B. Population sample from the reef flat at Slashers No.1 Reef on 17.8.70.
- C. Population sample from west side of lagoon at Bramble Reef on 13.12.69.
- D. Population sample from seaward slope, northern tip of Broadhurst Reef on 1.2.70.

20 Graphs showing size frequencies of populations of *A. planci*.
- A. Population sample from seaward slope, northern tip of Lodestone Reef on 29.5.70.
- B. Population sample from reef crest and seaward slope, south west corner of Trunk Reef on 14.12.69.

21 The giant triton, Charonia tritonis, approaching a specimen of A. planci which is feeding on a tabular acropore at Lodestone Reef (May, 1970).

22 Charonia tritonis captured while eating a specimen of A. planci at Nathan Reef (January, 1970).

A STUDY OF SOME ASPECTS OF THE CROWN-OF-THORNS STARFISH (ACANTHASTER PLANCI) INFESTATIONS OF REEFS OF AUSTRALIA'S GREAT BARRIER REEF

by R. Endean and W. Stablum[1/]

ABSTRACT

The region of Australia's Great Barrier Reef lying between approximately Lat. 15° and 19° S. is known to have been affected by population explosions of Acanthaster planci during the 1960's. About 150 patch reefs, each several square kilometres in extent, lie between Lat. 16° 34' S. and 19° 20' S., and 82 of these reefs including most of the larger ones were visited between August, 1969 and May, 1971. Although 46 of the 82 reefs carried few or no A. planci when visited, it is known that 18 of the 46 had carried large numbers of starfish at some stage during the 1960's, and it is possible that two other reefs also carried large numbers of starfish during this decade. On these 20 reefs a massive destruction of hard corals had occurred. The picture of coral destruction on these reefs contrasts markedly with that found on the 26 reefs visited which have not been infested with starfish during the 1960's. On these reefs the percentage of freshly killed coral in the total coral cover is very low.

Thirty-six of the 82 reefs visited were carrying large numbers of starfish and destruction of hard corals was in progress on these reefs. The amount and location on each reef of freshly killed hard coral was related to the stage of starfish infestation reached. Initially, damage was confined to deep water around the perimeter of the reef where starfish first appeared in large numbers. Subsequently, the coral destruction spread to other areas of the reef as starfish ascended reef slopes and invaded reef flats. Population densities as high as 15 adult starfish per square metre over thousands of square metres of reef were observed.

Juvenile starfish were confined to shallow water areas, principally on reef crests, and in most cases appeared to be the progeny of invading starfish. Invasion of reefs appears to result from adult starfish migrating between reefs rather than being due to larval carriage from reef to reef by currents.

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It is suggested that population explosions of A. planci first occurred during the early 1960's on accessible inner patch reefs near the major centres of human population in North Queensland and that subsequently there was a spread of starfish to adjacent reefs. This spread is continuing.

INTRODUCTION

Population explosions of the coral-eating starfish Acanthaster planci were observed on reefs of the Great Barrier Reef in the Cairns region during 1962. By early 1963 it was apparent that Green Island Reef, near Cairns, was infested with starfish which were causing obvious damage to the hard coral cover of the reef (Barnes and Endean, 1964). Subsequently, a survey of the apparent extent of infestation by A. planci of the reefs of the Great Barrier Reef was carried out during the period March, 1966 to August, 1968. It was found (Endean, 1969; Pearson and Endean, 1969) that the region of infestation (Fig. 1) embraced reefs in the region lying between approximately Lat. 15° 18' S. (Lark Reef) and approximately Lat. 18° 58' S. (Broadhurst Reef). Although only a third, approximately, of the reefs in this region were visited the picture which emerged was clear. Most inner patch reefs and some of the outer reefs visited carried unusually large populations of A. planci which were causing extensive damage to hard corals on these reefs. Towards the end of 1967 an apparent decline in starfish numbers, probably owing to scarcity of food, on some inner patch reefs in the Cairns-Innisfail area was noted. At the same time some evidence was obtained that other reefs immediately to the south of this area were coming under attack.

Although there can be no doubt that a catastrophic mortality of hard corals has occurred in the area (Endean, 1969; Talbot and Talbot, 1971) available estimates (Endean, 1969; Pearson and Endean, 1969) of the extent of destruction of hard corals on particular coral reefs caused by the feeding activities of A. planci lack precision. In most cases they are visual estimates relating solely to the percentage of dead coral in the total coral cover present in a sampled area of reef after the reef had been devastated by the starfish or while the devastation was in progress. Apart from a lack of precision such estimates could be somewhat misleading since they do not take into account the overall extent of the coral cover or the amount of dead coral normally found on the reef when A. planci is present at low population density.

There is a dearth of information about the manner in which reefs of the Great Barrier Reef become infested with A. planci and the respective roles played by juvenile and adult starfish in initiating these infestations. Also, little information is available concerning starfish predators and other factors which might have some bearing on the genesis of the starfish infestations of reefs in Queensland waters.

In view of the foregoing, it was decided in 1969 to visit as many as possible of the larger reefs in the region of the Great Barrier Reef lying between approximately Lat. 16° 30' S. and 19° 20' S. with a view to ascertaining whether starfish had departed from inner patch reefs in the Cairns-Innisfail region and whether inner patch reefs south of this area were coming under attack. It was also decided to ascertain whether outer reefs in the region between Lat. 16° 30' S. and 19° 20' S. had been attacked by the starfish. At each reef visited visual estimates were to be made of the density and distribution of A. planci and of the major types of reef cover, particular attention being given to the respective amounts of living coral and recently killed coral present. At selected reefs these estimates were to be supplemented by and checked against quantitative data obtained by a sampling technique. It was also decided to analyse the structure of A. planci populations on some reefs with a view to obtaining information on the respective parts played by juvenile and adult starfish in the infestations of reefs. In addition, a search for starfish predators was to be made on all reefs visited.

MATERIALS AND METHODS

During the period between August, 1969 and May, 1971 82 reefs (Figs. 2 & 3) of the Great Barrier Reef lying between Lat. 16° 34' S. and 19° 20' S. were visited, some on more than one occasion. The reefs in this region are generally regarded as patch reefs. Those lying nearer the 100 fathom line are termed outer patch reefs and those nearer the 20 fathom line are termed inner patch reefs. The mean distance between adjacent reefs in the region approximates 10 km. Some reefs visited are not named on official charts of the region. These reefs are referred to in Figs. 2 & 3 by names conferred on them by local fishermen.

At some localities a general survey of a sector of reef was made by swimming over the area while wearing face mask and snorkel or scuba gear. At other localities reef areas were examined through a glass-bottomed box while traversing the areas by boat or were viewed by a diver who was towed on a manta-board behind a boat. Usually, sectors of the perimeter of a reef including the seaward slopes from reef crest to sea floor were examined. Sectors on the normal weather side and on the normal lee side of each reef were usually chosen (south-east trade winds prevail for approximately nine months of each year in the region of the Great Barrier Reef visited). If numerous coral pinnacles ("bombies") were present in lagoons or in extensive back reef areas on reefs visited some of these pinnacles were also examined. Occasionally, reef flat areas were examined. In each case an estimate of the area examined was made.

Visual estimates (Table 1) were made of the apparent abundance of A. planci (wherever possible the number seen in a twenty minute period for ready comparison with the results obtained in the earlier study made by Pearson and Endean (1969) was noted) in the reef sector examined. Also, the apparent pattern of distribution of A. planci on each reef visited was ascertained wherever possible. Searches were made in the vicinity of any freshly killed hard corals encountered as A. planci is cryptic when present at low population densities. At each sector of reef visited the proportion of the total area of the reef surface examined which was covered by live hard corals plus the skeletons of recently killed hard corals still *in situ* (i.e. the total hard coral cover) was estimated and referred to one of the following categories for inclusion in Table 1: sparse (Fig. 4), moderate (Fig. 5), dense (Fig. 6). Likewise, the proportion of recently killed hard corals (skeletons still *in situ*) in the total hard coral cover was estimated and referred to one of the following categories for inclusion in Table 1: low (Fig. 7), marked (Fig. 8), high (Fig. 9). Normally, no difficulty was encountered in assigning the total coral cover or the proportion of dead hard coral in the total coral cover of a reef sector examined (Figs. 10 and 11) to one of these categories but if some doubt existed this is indicated in Table 1. The extent of the soft coral (alcyonarian) cover present in each reef sector examined was also assessed.

At certain localities sampling stations were selected and attempts were made using a sampling technique developed by J. Laxton and W. Stablum to obtain quantitative data on the percentage of the area of the reef sampled which was covered by live hard corals (LHC), by the skeletons of recently killed hard corals remaining *in situ* (DHC), by soft corals (SC) and by algal-dominated substratum (ADS). These four categories of reef cover accounted for the bulk of the cover observed. Living sedentary animals other than hard and soft corals (e.g. sponges, gorgonians, anemones, colonial anemones, tunicates) were found attached to the substratum in the areas sampled but they comprised usually less than 1% of the total cover observed.

No difficulty was experienced in the field in distinguishing between living and dead corals. Recently killed corals were recognized by their stark white skeletons. It was noted that within two to three weeks these skeletons acquired a fine greyish or greenish coating of filamentous algae. Subsequently the algal covering thickened and darkened and coral skeletons became covered with dark tufts of filamentous algae. In some cases at least, coralline algae ultimately covered parts of the skeletons which can remain *in situ* for extended periods. For example, Pearson and Endean (1969) refer to the skeletons of two dead coral colonies which had remained *in situ* at Green Island Reef for almost three years when last observed. On the reef crests of some reefs a few hemispherical nodules were observed which, upon examination, were found to be comprised of coral skeletons heavily encrusted with coralline algae. These were included in the category of algal-dominated substratum but otherwise coral skeletons remaining in situ, irrespective of whether they were covered with algae or not, were placed in the category of dead hard corals. The category termed algal-dominated substratum included occasional patches of loose coral sand and apparently bare areas but, in the main, was comprised of consolidated and semi-consolidated reef debris covered with algae. Coralline algae predominated but other types of algae, particularly short filamentous forms, were represented and were especially common in some areas (e.g. reef crests). However, no attempt was made to differentiate among the algal species encountered.

The sampling technique used to obtain quantitative data involved the running out of a 100 metre transect line, marked off in one metre lengths, across the region to be sampled. As far as was possible under the conditions prevailing at the time of the visit a station or stations were chosen on the normal weather side and on the normal lee side of each reef visited. One end of the transect line was normally anchored in water 5 - 20 metres deep, seawards from the reef edge, the line run out towards the nearest point on the reef crest and secured on the reef crest or reef flat at some distance (10 - 30 metres) from the reef edge. Usually this procedure resulted in the line being oriented at right angles to the reef edge in the region sampled. Also, particularly on windward sides of reefs, it usually resulted in the transect line traversing the seaward slopes of the reef sampled from sea floor to reef crest.

Estimates of the percentage cover of LHC, DHC, SC and ADS respectively were made as follows: a metre square grid was placed at the start of the transect line and photographed from a point perpendicular to the plane of the grid and at a distance of approximately 2 metres from it. When the slope of the reef surface below the transect line was less than 70° from the horizontal the grid was photographed in a similar way at intervals of ten metres along the transect line. When the slope was greater than 70° the grid was photographed at shorter intervals. Sometimes conditions (heavy wave action, strong currents, poor visibility etc.) were unfavourable for transect work and fewer quadrat photographs than usual were taken.

Two identical prints (Fig. 12) were made of each negative obtained. One was kept as a record. From the duplicate the images of living hard corals, recently killed hard coral skeletons in situ and soft corals respectively were carefully excised. The remainder of each print was regarded as representing algal dominated substratum. The pieces belonging to each category were weighed to the nearest 0.0001 gram. Each weight thereby obtained was then expressed as a percentage of the total weight of the print. This procedure yielded the percentage area of each print occupied by each category of reef cover investigated and it was assumed that the figure obtained in each case corresponded with the actual percentage area occupied by the particular category of reef cover in the area of reef surface depicted in the print. It was intended that the area of each print should correspond with the area of the quadrat (1 metre squared) used. However, this was frequently not the case and the area of each print merely approximated 1 metre squared (mean for 551 prints was 1.12 m^2 and the range was 0.82 - 1.88 m^2. Mean figures for the percentage area occupied by each category of reef cover on each transect were then calculated and are listed in Table 2.

Attempts were made to assess the density and distribution of *A. planci* at each transect made. The number of specimens visible in each quadrat was determined (Fig. 13). Information on the size frequency distribution within starfish populations on some reefs was also obtained. To obtain this information without disturbing the population the maximum radius of each starfish was measured *in situ* in some cases.

RESULTS

The reefs visited, estimates of the area of each reef sector sampled, estimates of the percentage of each reef area sampled which was covered by live hard corals and the skeletons of recently killed hard corals still *in situ*, estimates of the percentage of recently killed hard corals in the total hard coral cover and a description of the general condition of the reef cover are given in Table 1. Also included in Table 1 is information on the apparent abundance and distribution of *A. planci* in the areas of each reef examined. Data obtained from quadrat sampling along transects made on 24 reefs are presented in Table 2. These data include figures for the percentage of the total reef cover occupied by each of the 4 categories of reef cover selected for detailed investigation, the percentage of the total hard coral which had recently been killed and the mean number of coral colonies per print. The number of colonies per print approximates the number per quadrat (i.e. per m^2). It should be noted that the figures presented reflect the actual situation only for the areas specified at the dates specified. Because of camera malfunctions, incorrect exposures etc., a few quadrat photographs were unsuitable for analysis and were discarded. The number of quadrat photographs included in the analysis of each transect is given.

It can be seen from Tables 1 and 2 that the percentage of the surface of a reef which is covered by living hard corals and the skeletons of recently killed hard corals remaining *in situ* (i.e. the total hard coral cover) varies markedly from reef to reef and from one region to another of the same reef. Water depth and degree of exposure to wave action were two factors which obviously affected the density of hard corals growing in any particular area of a reef but no attempt was made to assess the relative importance of these or other factors. It might be mentioned however, that although hard corals were usually well developed on the seaward slopes of the reefs visited they usually became sparser in water deeper than about 15 m. Even so, they were usually well represented on seaward slopes until the consolidated and semi-consolidated material comprising the reef proper merged with unconsolidated coral sand and reef debris around the perimeter of the reef. The depth at which this occurred varied somewhat from reef to reef but in general was about 25 m for the inner platform reefs and about 35 m for the outer platform reefs visited. The extent of the surface of a reef covered by soft corals varied from reef to reef and from one part to another of the same reef. A variable but frequently high percentage of the surface of each reef sector was devoid of living hard or soft corals or the skeletons of recently killed corals. Usually these reef areas were dominated by algae, particularly calcareous algae.

Despite intensive searching of areas visited by trained observers familiar with the behaviour of A. planci, specimens of the starfish were not observed on 36 of the 82 reefs visited. Less than 4 starfish were seen on each of another 10 of the 82 reefs visited. It is known that 13 of these 46 reefs which appeared to be devoid or virtually devoid of A. planci in 1969, 1970 or 1971 had carried large numbers of starfish at some stage during the 1960's (Endean, 1969; Pearson and Endean, 1969) and reports from reliable witnesses have been received that another 5 reefs (Cayley, McCulloch, Hall-Thompson, Eddy and Farquharson) visited during the recent survey but not visited when the earlier studies were made were also invaded by starfish during the 1960's. It is noteworthy that destruction of hard corals as evidenced by the ratio of recently killed hard coral skeletons in situ to total hard coral cover on these 18 reefs has been particularly heavy and the living hard coral cover of these reefs is now remarkably sparse. The percentage of coral skeletons in the total hard coral cover of these reefs (as well as the total hard coral cover) would in many cases be even higher if allowance had been made for the fact that soft corals (Figs. 14 and 15) have covered the skeletons of many of the recently killed hard corals. Indeed, on many of these 18 reefs soft corals cover extensive areas and have obviously proliferated after hard corals were destroyed since they have grown over the skeletons of recently killed corals.

Of interest was the finding that coral damage caused by starfish was extensive on only the lee sides of another two reefs apparently devoid of A. planci when visited in 1971. One of these reefs, Horseshoe Reef, had not been visited during the 1960's. The other, Potter Reef, had been visited briefly in 1969 but starfish which must have been present in the lagoon at this time were missed. Some damaged corals were in fact observed on this reef in 1969 but the damage was attributed to storms.

As far as can be established the remaining 26 reefs which were devoid of A. planci during the recent visits had not carried abnormal numbers of the starfish at any stage during the last decade. Two starfish were observed during a 15 minute search at Noggin Reef in 1966 (Pearson and Endean, 1969) but invasion of this reef by large numbers of starfish does not appear to have occurred since the hard coral cover in the areas visited in 1970 showed no evidence of recent damage attributable to A. planci. Some recent coral damage possibly caused by starfish was apparent near the reef crest at Hedley Reef but the damage was not extensive and no starfish were observed when this reef was visited in 1970.

It is instructive to note that the skeletons of recently killed hard corals remaining in situ formed only a minor percentage (usually less than 10%) of the cover of the 26 reefs which had not carried large numbers of A. planci during the last decade. The dead hard coral which occurred was mainly confined to the higher parts of the reef crest, to the tops of coral pinnacles lying to windward of the reef crest or in back reef areas and to reef flats. These are all regions which may be bared to the atmosphere periodically at times of low water spring tides. They are also regions subjected periodically to heavy wave action. There was also a slight increase in the ratio of dead to live hard coral with increasing depth on some of the reefs visited. A higher ratio of dead to living coral was normally found in lagoons and on reef flats than on the seaward slopes of reefs.

Alcyonarians were conspicuous among the surface cover of the 26 reefs which had not carried large numbers of A. planci during the last decade but they accounted for only a minor percentage (usually much less than 10 per cent) of the surface cover of these reefs. They tended to occur more commonly in lagoons and back reef areas than on seaward slopes.

Figures reflecting the amounts of dead coral cover on reefs which were under attack by A. planci varied depending on whether the starfish had been active in the area sampled. Of the 82 reefs visited during the period August, 1969 to May, 1971, 36 reefs were found to be carrying numerous specimens of A. planci and on these reefs the starfish were causing obvious damage. Starfish densities in terms of the number seen per 20 minute swim (Table 1) ranged from 0 to 526 in the areas of these reefs sampled. However, it became apparent that normally the starfish were not uniformly distributed. Instead, they tended to aggregate in particular reef areas. The location of each group of starfish was related to the stage of infestation of the reef reached and also to the mean size of the starfish. During the earlier stages of infestation of a reef the starfish tended to be cryptic and nocturnal. Subsequently, when they moved onto the reef flat, they fed during daylight hours and many were completely exposed at such times (Fig. 16). Sometimes the arms of adjacent starfish overlapped and a coral colony became completely enclosed by a mass of feeding starfish (Fig. 17). Because starfish were not uniformly distributed on a reef and because they showed cryptic behaviour at some stages of infestation of a reef but not at others, attempts to estimate starfish numbers on transects were abandoned.

Initial infestation of a reef in the region investigated appeared to occur at some point or points at the foot of the seaward slopes around the perimeter of the reef. At this stage starfish numbers were relatively small and coral damage was patchy. However, it was possible to follow the trails of dead coral left by the starfish, the earlier parts of the trails being several weeks old. Indeed, location of the starfish often depended upon observing the trail of dead coral as the starfish were cryptic at this stage. It is significant that juvenile starfish were not found among the early invaders in the deep water around reefs. Yamato, Tabias, Mid, Dolphin, Centipede, and Tiger Reefs appeared to be at this early stage of infestation when visited in 1970.

Apparently the ranks of the early invaders are swollen by later arrivals and the starfish begin to ascend the seaward slopes of the reef. In July, 1970 starfish were observed in deep water around the perimeters of Dip and Coil Reefs but were not found in shallow water areas of these reefs. Only in the areas where the starfish were observed was there evidence of marked coral destruction. At Trout Reef in December, 1969 large numbers of adult starfish were congregated in water about 33 metres deep near the foot of the seaward slopes on one sector of the reef. Marked coral damage was confined to this sector. When the reef was visited approximately 4 weeks subsequently it was noted that many of the starfish had moved through distances of several metres up the reef slope. Their paths of ascent could be traced readily by the trails of recently killed corals which they left behind. Coral damage on other regions of Trout Reef examined at the time was slight and no adult specimens of *A. planci* were observed in these other areas. Trails of freshly killed coral which marked the paths of ascent of seaward slopes by starfish were observed on other reefs and were especially prominent at Glenda and Seeker Reefs when these were visited in May, 1971.

When John Brewer Reef and Lodestone Reef were examined in January, 1970 the bulk of starfish and the bulk of coral damage were confined to the deeper regions of the seaward slopes around the perimeters of the reefs and to the lower parts of the vertical or near-vertical faces of coral pinnacles. Coral on the reef crests, upper parts of the seaward slopes and on the reef flats was largely undamaged at this time. By July, 1970 starfish had invaded the upper parts of the seaward slopes at both localities and were observed on vertical and near vertical faces near the tops of coral pinnacles on the lee side of each reef. At John Brewer Reef adult starfish were observed to be eating the coral in the upper 3 m on some sectors on the windward side of the reef despite exposure to wave action.

In October, 1970 large numbers of A. planci were observed attacking corals on the seaward slopes of Glow Reef. By January, 1971 they had killed the bulk of the coral on the slopes and were congregated on the upper parts of the seaward slopes near the reef edge. In October, 1970 A. planci was observed attacking corals on the vertical and near vertical seaward slopes of Grub Reef. By January, 1971 destruction of corals on the seaward slopes was well advanced and adult starfish were concentrated near the reef edge.

After killing the bulk of coral on the seaward slopes around the perimeter of a reef the starfish may invade the reef flat in very large numbers. In September, 1969 a large herd of starfish was encountered on the reef flat near the sand cay at Taylor Reef. The herd appeared to be completing the destruction of thick beds of branching acropores. Twelve months later it was found that most of the dead branching corals in the shallow water near the cay had been broken to form piles of rubble. In July, 1970 very large numbers of starfish were observed to be massed on the reef flat at Slashers No.1 Reef. The main group occupied an area of several thousand square metres. It was surrounded by smaller groups of starfish and other groups of starfish were observed to be moving into the area from the north and the west. A second visit two weeks later revealed that the centre of the main group was about 200 m to the south of its previous position. Starfish occurred on the reef flat at densities as high as 15 per square metre over thousands of square metres. Areas of coral which were alive but in the path of the feeding starfish at the time of the first visit were dead at the time of the second visit. The trail of dead corals left by the migrating starfish herds could be followed readily. It extended northwards for at least 800 m. Freshly killed coral in the vicinity of the feeding starfish was stark white while skeletons to the north showed progressive fouling by algae.

When the bulk of hard corals on a reef flat have been killed starfish move back into deeper water. In early 1970 large numbers of A. planci were observed moving across the devastated reef flats to the reef edges of Bramble Reef and Trunk Reef. However, adult starfish do not usually invade the reef crest area or the tops of coral pinnacles and reef flats subject to emersion at low tide. For example, although large numbers of starfish caused almost total destruction of hard corals on the seaward slopes of Lodestone Reef, adult starfish departed from the reef in 1970 without invading the reef flat to any great extent.

Infestation of some outer patch reefs may follow a different course. Large numbers of juvenile starfish and a few adults were found on some coral pinnacles in the lee of Nathan Reef in 1969 and 1970 but invasion of the seaward slopes or reef flat had not occurred. The juveniles were confined to shallow water. A few juveniles but no adults were found in shallow water at Birthday Reef in 1969. In this connection it should be noted that small juvenile specimens of _A. planci_ were found only in shallow water near reef crests and on the tops of coral pinnacles despite intensive searches for them in a variety of habitats. Data on size frequencies of starfish in population samples taken from nine reefs are incorporated in Table 4 and in Figs 18, 19 and 20.

Fig. 18 A shows the size structure of an _A. planci_ population consisting entirely of juveniles found on the reef crest of Slashers No.4 Reef in January, 1971. Their mean size would indicate that they were approximately 12 months old (Pearson and Endean, 1969). Fig. 18 B shows the size structure of a population sample of juvenile _A. planci_ taken from the reef crest at Glow Reef in January, 1971 and the structure of a sample of _A. planci_ taken from the seaward slopes of Glow Reef at the same date. Obviously the small juveniles tend to keep together during their first year.

Figs. 18 C and 18 D show the size frequency of two samples of a population of _A. planci_ associated with a large coral pinnacle in a back reef area at Nathan Reef. The first sample was taken in September, 1969 and the second in January, 1970. It was noted that the larger starfish in each sample occurred in deeper water around the perimeter of the pinnacle but unfortunately records were not kept of the exact sites from where representatives of each size group in the population sampled were collected. It was of interest that other coral pinnacles in the area which were examined carried few or no starfish and the infestation observed appeared to be a localized one.

According to Pearson and Endean (1969) juvenile _A. planci_ grow at the rate of about 1 cm per month. However, it is not known whether this growth rate is maintained after the end of their second year when most probably mature. Strong domination by certain size groups and apparent year groups characterizes the populations sampled at Big Sand Cay, Bramble Reef and Slashers No.1 Reef (Figs.19 A-C). However, different year groups could be represented and are almost certainly represented in Fig.19 D, Fig. 20 A and Fig. 20 B. Indeed, small juveniles are included in the population sampled from Trunk Reef (Fig. 20 B).

The fact that starfish were observed to be aggregated on reefs during all seasons of the year rules out the possibility that the starfish aggregations are breeding aggregations (Pearson and Endean (1969) have shown that _A. planci_ breeds during the summer months).

During this survey 22 adult and two large juvenile specimens of the giant triton (Charonia tritonis) were found (Figs. 21 and 22). All except two were lying fully exposed among corals when found (Table 3). They occurred on windward and lee sides of reefs and in lagoons. Five specimens of C. tritonis were eating A. planci when encountered. Four of the A. planci specimens were large juveniles about 20 cm in diameter, the other was adult. Two tritons were eating holothurians when found. One large recently dead specimen of C. tritonis was encountered. Its shell was intact but its flesh was putrefying. The cause of death was not ascertained.

Pieces of discs and arms from adult specimens of A. planci which had been recently killed and torn apart were observed at Broadhurst Reef (two specimens), John Brewer Reef (one specimen) and Slashers No.4 Reef (two specimens). A large hump headed wrasse (Cheilinus undulatus) was observed mouthing a macerated specimen of A. planci at Slashers No.4 Reef but it is not known whether the wrasse had seized and dismembered the starfish initially.

DISCUSSION

This study was hampered by the great extent of the region of the Great Barrier Reef which has been affected by the A. planci infestations and hence warranted detailed investigation. It was hampered too by the small number of personnel involved and by the limited period of time (a few hours) which could be spent on each of the many reefs visited, most of which were several square kilometres in extent. All of this restricted the amount of quantitative data which could be obtained. Moreover, numerous difficulties attend attempts to carry out quantitative transect work on coral reefs. Some of these difficulties have been discussed recently by Stoddart (1969). In particular, because of the variation in growth form assumed by different coral colonies the accuracy of methods involving quadrats in the sampling of the percentage area of reef surface covered by each major category of reef cover may well be questioned. Inevitably, the projection onto a flat surface (film) of the images of corals which branch extensively in all planes from the point of attachment gives rise to problems if the projection is used to assess the extent of the reef surface covered by corals. Furthermore, some corals such as the common plate coral Acropora hyacinthus tend to grow out on a tubular "stalk" from the region of attachment before expanding to form a "plate" in a horizontal or near horizontal plane. When photographed from a point at right angles to a reef face these corals usually appear to occupy a much smaller area of the reef surface if they grow out from a vertical or near vertical reef face than is the case when they arise from a horizontal or near horizontal reef Then too, the sampling frequency along the transect line when it is placed on parts of those reefs where seaward slopes are steep requires detailed study in order to select an optimal frequency for subsequent statistical analysis.

Likewise, the optimal number of stations for transect work that should be set up on a coral reef of mean size for the region of the Great Barrier Reef visited if the surface cover of the reef is to be satisfactorily sampled has still to be determined. It will be appreciated that the limited amount of time which could be spent on any reef during the present investigation prevented the establishment of an adequate number of sampling stations. In view of all this the transect data obtained could not be used to provide accurate estimates of the surface cover of any of the reefs visited. Indeed, if reliance were placed solely on such transect data the estimates obtained could be misleading. However, the transect data obtained enabled checks to be made at particular reef sites on visual estimates of the total coral cover and of relative amounts of dead and living coral in the total coral cover. Much greater areas of reef were viewed when visual estimates were being obtained than were involved in the transect work undertaken thereby enabling a better assessment of the overall picture at each reef visited to be made.

Although the degree of accuracy which could be attained when making visual estimates is limited, difficulty was rarely experienced in referring visual estimates of total coral cover and of the extent of recently killed coral in the total coral cover of a reef to appropriate categories among those illustrated in Figs. 4-9. Particularly was this so with visual estimates of the extent of recently killed coral in the total coral cover. Indeed, it emerged from the present study that on those reefs or areas of reefs investigated which are as yet unaffected by the feeding activities of *A. planci* the number of skeletons of recently killed hard corals remaining *in situ* normally constitutes a minor percentage (certainly less than 10%) of the total coral cover. In fact, dead coral skeletons *in situ* were rarely seen on the seaward slopes of those reefs visited which have not been invaded by *A. planci*. The marked increase in the percentage of coral skeletons *in situ* on reefs which have been invaded by *A. planci* is apparent from analysis of the figures given in Table 2 and from the visual estimates listed in Table 1. Although the proliferation of soft corals which follows destruction of hard corals in some reef areas has masked, to some extent, the actual magnitude of the destruction which has occurred in many areas, particularly sheltered areas of inner patch reefs devastated during the mid 1960's, the results obtained are unequivocal. On the reefs visited which had already been invaded by *A. planci* it is apparent that massive destruction of hard corals has occurred and that living hard corals now form a remarkably small percentage of the total reef cover. Precise figures for the extent of the hard coral cover killed by *A. planci* on the reefs are not available but the new data obtained support earlier estimates made by Pearson and Endean (1969) that the great majority of hard corals on these reefs have been killed by *A. planci*. Indeed, there is no question that almost every coral colony in an extensive area of reef under attack by large numbers of A. planci can be killed by the starfish in a short period of time. Such destruction has been witnessed and photographed at the reefs of the Slashers complex for example. There is also no doubt that a massive destruction of corals owing to the feeding activities of A. planci can occur over a whole reef. Such destruction was observed, for example, to occur within a few months at John Brewer Reef after the reef had been invaded by large numbers of starfish.

Available information would indicate that the bulk of the hard corals on many reefs of the Great Barrier Reef investigated was killed within 2-6 years after large numbers of starfish were observed on the reefs. Many factors would influence the rate of destruction of the corals at a particular reef. However, as a reef of mean size in the area investigated normally carries many square kilometres of coral and as each adult starfish kills about 6 sq m of coral per year (Pearson and Endean, 1969) it is apparent that tens of thousands of adult starfish must be involved in the destruction of coral at each reef.

On some reefs such large numbers of A. planci were undoubtedly present. Densities as high as 15 adult starfish per sq m over an area of several thousand square metres have been observed (and photographed). However, it has become apparent that the location of feeding starfish and, to a large extent, the degree of aggregation of starfish are dependent on the stage of infestation of a reef reached and on the distribution of corals, particularly acropores, on the reef. Because of this the data on starfish densities obtained at sectors of each reef examined (particularly those obtained during transect work involving only small areas of reef) cannot be extrapolated to give figures for the density of starfish over the reef as a whole. Also, it would be easy for divers, even divers experienced with A. planci, to visit briefly a portion of a reef which was devoid of starfish and to miss completely large concentrations of starfish present on other areas of the same reef. Then again, once they have killed the bulk of corals on a coral reef (except those in very shallow water on reef crests and the tops of coral pinnacles) adult starfish depart from the reef. It may have been the operation of factors such as these which caused Weber and Woodhead (1970) and Vine (1970) to underestimate seriously the extent and severity of the starfish infestations of reefs in the central region of the Great Barrier Reef.

Pearson and Endean (1969) have arbitrarily selected a figure of 40 starfish seen per 20 minute swim as constituting an infestation. This figure is arrived at by making certain assumptions. The first assumption is that in one year a 25% kill of hard corals in an area completely covered by corals is significant. The second assumption is that an adult starfish kills about 6 sq m of coral per year. The third assumption is that 1000 sq m of reef can be examined in 20 minutes by a diver.

It is possible that the figure of 40 starfish seen per 20 minute swim as an indicator of an infested reef may be set too high. The hard coral cover of a reef would rarely exceed 50% of the total reef cover. Then again, Chesher (1969) maintained that an adult A. planci killed about 12 sq m of coral per year. Moreover, A. planci tends to be cryptic during the early stages of invasion of a reef, normally hiding during the day. T. Brown (personal communication) has counted 22 adult starfish hidden beneath one large tabular acropore. In view of all this it is of interest to note that Chesher (1969) has selected a figure of 20 A. planci seen per 20 minute swim as indicating the possible existence of a starfish infestation. This raises the question of the manner in which reefs become infested by starfish.

The available evidence indicates that large numbers of A. planci appeared suddenly on those reefs of the Great Barrier Reef which have recently become infested by the starfish. Two mechanisms can be invoked to account for the sudden appearance of A. planci on these reefs. One mechanism involves the carriage of large numbers of pelagic starfish larvae to a reef by currents, the other involves the migration of starfish across the sea floor from one reef to another. It seems likely that juvenile starfish settle principally in shallow water near reef crests and the tops of coral pinnacles. Certainly these were the only regions where juvenile starfish were found during the present investigation despite an intensive search for them in a wide selection of the major habitats provided by a coral reef. Only rarely were large numbers of juvenile starfish found on a reef in the apparent absence of substantial numbers of adult starfish on the same reef. Indeed, of the reefs visited only Nathan Reef appeared exceptional in this regard. At this locality large numbers of juvenile starfish were present on the tops of a few coral pinnacles in the lee of the main reef which appeared to be free of A. planci. However, a few large adult starfish were found in deeper water around the pinnacles carrying the juvenile starfish and the juveniles could have been the progeny of these adults.

On the other hand, large numbers of adult starfish were found on some reefs which appeared to be free of juvenile starfish. It is significant that initially the adult starfish on these reefs were found principally in the deeper water around the peripheries of the reefs and that the bulk of the coral in shallow water on such reefs showed little damage which could be attributed to A. planci. Indeed, the weight of evidence obtained during the present investigation indicates that those reefs which have recently become infested by starfish have been invaded by adults which have migrated to the reefs across the sea floor. The invasion pattern would appear to involve the following sequence of events. Adult starfish arrive at one or more points at the foot of the seaward slopes around the perimeter of a reef. As numbers of invaders increase and the coral in the deeper water around the perimeter of the reef is killed the starfish ascend the seaward slopes of the reef. Initially, the adult starfish tend to avoid shallow reef areas exposed to wave action and they move peripherally around the reef following the contours of its seaward slopes. Amalgamation of groups of feeding starfish becomes more pronounced as coral destruction increases. Eventually coral on the reef edge is attacked and the starfish may then move onto the reef flat and the tops of coral pinnacles, hunger probably overcoming their erstwhile photonegative behaviour. Very large herds of migrating starfish are frequently seen during the day by the casual observer at this stage. When the bulk of the available coral has been exhausted the migrating starfish then move into deeper water and depart from the reef.

Normally, large numbers of juvenile starfish appear on a reef subsequent to the arrival of large numbers of adults on the reef and it is probable that the juveniles are the progeny of the invading adults. *A. planci* breeds only during the summer months and it would seem that the extent of the participation of juvenile starfish in destruction of coral at a particular reef would depend upon the season when adults invade the reef as well as on the rapidity with which the adults kill the reef's coral. This, in turn, depends on the number of adults present and the amount of coral present (assuming that the adults feed at a constant rate throughout the year). It is significant that juvenile starfish are found in shallow water on the reef crest and on the tops of coral pinnacles, regions normally avoided by adult starfish.

Recent charts of the region of the Barrier Reef lying between Lat. 16° 34' S. and 19° 20' S. (the region embraced by the present survey) show the positions of approximately 150 recognizable reefs (fringing reefs of mainland islands are excluded). Of these 150 reefs 82 were visited between August, 1969 and May, 1971. Another 8 reefs in the region (Oyster, an unnamed reef at Lat. 16° 39' S., Elford, Briggs, Maori, Scott, Stevens, and Rib Reefs) were visited during 1966-1968 by Pearson (Pearson and Endean, 1969). These 90 reefs visited include all the larger reefs in the region. Most of the remaining 60 are very small. A study of the results of Pearson and Endean (1969) will reveal that by December, 1966 most, if not all, the inner platform reefs between Michaelmas Reef (Lat. 16° 34' S.) and Beaver Reef (Lat. 17° 51' S.) were already heavily infested with starfish. By 1970-71 starfish were absent from these reefs and the bulk of the hard corals present on these reefs appeared to have been killed by the starfish. As evidenced by the paucity of living hard corals and the abundance of skeletons of recently killed corals still *in situ* destruction of corals had been extremely heavy and in many cases was almost total. Further to the south, Otter Reef and Rib Reef were at least partially infested by the end of 1966 (as was the fringing reef at the Palm Islands) but, as far as can be ascertained, other patch reefs south of Beaver Reef carried few or no starfish at the end of 1966. None was seen at Britomart Reef and John Brewer Reef and only 2 specimens at the reef complex known as The Slashers and 2 specimens at Trunk Reef when these were examined at the end of 1966 (Pearson and Endean, 1969). John Brewer Reef and Lodestone Reef were both free of starfish in 1968 (T. Brown, personal communication). Britomart, John Brewer, Lodestone, Trunk and the reefs of the Slashers complex all carried starfish in plague proportions during 1969 and 1970. Other reefs still further to the south were observed to be invaded by starfish during 1969, 1970 or 1971 as were some of the outer patch reefs (Trout, Josephine, Big Sand Cay) east of Otter Reef during this period.

In general there appears to have been a southward spread of the starfish plague to inner patch reefs between Lat. 18° S. and 19° S. and to many outer patch reefs between Lat. 17° S. and 19° S. during the latter half of the 1960's. On some reefs lying in these regions such as Yamacutta, Taylor, Beaver, John Brewer, the reefs of The Slashers, Lodestone, Britomart and Bramble, the bulk of the hard coral cover had been killed by early 1971 and it can be expected that these reefs will be free or vitually free of adult starfish in the near future. Indeed, starfish numbers have already declined markedly on some of these reefs (e.g. Taylor, John Brewer, Lodestone, reefs of The Slashers). Other reefs such as Glow, Grub, Dip, Coil and Keeper have only recently come under attack by large numbers of A. planci and areas of rich growths of living coral still remained when these reefs were last visited.

It would appear that starfish invasions of Centipede, Dolphin, Yamato, Tabias, Tiger, Pollux, and Mid Reefs had just begun in August, 1970 and it is possible that most of the reefs between Lat. 19° S. and 20° S. will come under attack by starfish during the 1970's. Twenty-six of the 90 reefs visited in the area surveyed were free of starfish and the condition of their hard coral cover would indicate that they had not been invaded by large numbers of A. planci in recent years. However, some of these reefs are near reefs already infested and it is to be expected that invasion of some of these reefs is imminent.

Of interest was the finding that some of the outer patch reefs in the region between Lat. 16° 34' S. and 19° S. were still free of starfish in 1970 and 1971. In some cases the lagoons or back reef areas of the outer patch reefs had been invaded but the seaward slopes on the weather sides had escaped infestation. Adult A. planci appear to avoid areas exposed to heavy wave action and this may provide an explanation for the virtual absence of A. planci from some of the outer patch reefs. It is also of interest that, with one apparent exception, juvenile starfish are not present on these outer patch reefs even though some of them are close to reefs which carry or carried large numbers of A. planci.

Some information was obtained about predators of A. planci. Charonia tritonis, a formidable predator of the starfish (Endean, 1969) was found among coral on seaward slopes and on coral pinnacles in lagoons. Because of its large size, its characteristic shape and colouration and because it usually lies completely exposed among corals, the giant triton is readily detected by experienced divers. In view of this, the fact that only 24 specimens were encountered during visits made to 81 reefs would indicate that C. tritonis is a somewhat rare species, at least on the reefs visited. Five of the giant tritons seen were feeding upon specimens of A. planci and two were feeding upon holothurians when found. It is of interest that 4 of the specimens of A. planci being eaten were large juveniles about 20 cm in diameter. Possibly A. planci of this size are preferred by the tritons. No juvenile Charonia tritonis less than 14 cm in length were encountered.

Not a single specimen of the giant helmet, Casis cornuta, a possible predator of A. planci (Endean, 1969) was encountered during the trips to 82 reefs. It is known that shell collectors have found giant helmets in the lagoons of two of the reefs visited (Sudbury Reef and Taylor Reef) in recent years.

While the hump headed wrasse was not observed to seize and dismember A. planci one large specimen of this fish (the species attains a length of approximately 2 metres) was observed mouthing fragments of a specimen of A. planci. It is possible that this species is a predator of A. planci.

No information pinpointing the causes of the A. planci plagues in Barrier Reef waters was obtained during the investigation. Indeed, the initial causes of the population explosions of A. planci may no longer be operative. However, a study of the results of the earlier investigation (Endean, 1969; Pearson and Endean, 1969) in conjunction with a study of those of the present investigation suggest that the starfish infestations can be traced back to several foci--accessible inner platform reefs near the major centres of human population on the coast of Queensland between Cooktown and Townsville. If the Great Barrier Reef starfish plagues did begin on these accessible reefs it is possible that the plagues are man-induced. A release of predator pressure on adult and large juvenile starfish as a result of intensive collecting of Charonia tritonis by shell collectors operating on accessible reefs could have triggered the plagues as suggested by Endean (1969). C. tritonis is a predator of high trophic status and can be regarded as a keystone species in the sense used by Paine (1969). It is possible that other factors could have contributed to a decline in numbers of C. tritonis. For example, toxic residues from pesticides or other pollutants emanating from centres of human population on the Queensland coast could have accumulated in the tissues of specimens of C. tritonis until levels which were lethal or levels which interfered with reproduction were attained. Also, it is possible that factors other than a reduction in numbers of C. tritonis on accessible reefs could have triggered the plagues.

Whatever the causes of the increases in starfish numbers on accessible reefs near major centres of population on the Queensland coast between Cooktown and Townsville, it would appear that the increases occurred almost simultaneously on those reefs during the early 1960's. Subsequently, as food supplies on these reefs became exhausted, adult starfish migrated from these initial centres of infestation to adjacent reefs. This process has continued throughout the last decade. It is apparent that massive damage to the corals of most reefs in the region of the Great Barrier Reef investigated (the region between Lat. 16° 34' S. and 19° 20' S.) during the present study has already occurred. Also, it would seem likely that similar destruction has been caused to the coral cover of most reefs in the region of the Great Barrier Reef lying between Lat. 15° 18' S. and 16° 34' S. where starfish infestations were reported earlier (Pearson and Endean, 1969). It is possible that migrating starfish could encounter unfavourable conditions on the reefs now being invaded and that the starfish plagues will attenuate during the 1970's. However, no evidence for the occurrence of such an attenuation has so far been obtained. On the contrary, additional reefs of the Great Barrier Reef are coming under attack and a recruitment of juveniles to the *A. planci* populations of at least some of the reefs currently under attack is occurring. Obviously, measures should be adopted to control the starfish plagues while their causes are investigated and their probable consequences assessed.

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TABLE 1. REEFS VISITED WITH DETAILS OF AREAS SAMPLED, NUMBER AND DISTRIBUTION OF *ACANTHASTER PLANCI*, ESTIMATES OF TOTAL HARD CORAL COVER AND RECENT DESTRUCTION

Reef and date visited	Type*	Position of area examined^x	Depth range (m)	Estimated area sampled (m^2)	Number and distribution of *A. planci***	Total hard coral cover+	Hard coral skeletons *in situ* ++
Michaelmas 3.5.70	IP	N. tip, back reef area	0-5	10,000	1 A on massive coral	S-M	H
Remarks:	Hard coral mostly dead. Obvious damage by starfish. Soft coral cover extensive.						
Michaelmas 3.5.70	IP	N. tip, seaward slope	0-10	2,000	Nil	D	L
Remarks:	Hard coral well developed. No damage by starfish.						
Upolo 3.5.70	IP	E. side, seaward slope	0-5	3,000	Nil	M	H
Remarks:	Hard coral mainly dead. Obvious damage by starfish. Water turbid.						

* OP = outer patch reef; IP = inner patch reef.

x N. = north; E. = east; S. = south; W. = west.

** A = adult; J = juvenile.

+ S = sparse (c.f. Fig. 4); M = moderate (c.f. Fig. 5); D = dense (c.f. Fig. 6).

++ L = low (c.f. Fig. 7); M = marked (c.f. Fig. 8); H = high (c.f. Fig. 9).

Table 1 cont'd.

Arlington 5.11.70	IP	S.E. tip, seaward slope	0-5	10,000	Nil	D	H
Remarks:	Massive destruction of hard coral. Large areas of soft coral. Obvious starfish damage to hard coral.						
Arlington 5.11.70	IP	S.W. side, seaward slope	0-5	10,000	Nil	D	H
Remarks:	Massive destruction of hard coral. Soft coral cover extensive. Obvious starfish damage to hard coral.						
Green 2.5.70	IP	W. of cay, reef flat	0-5	10,000	Nil	S	H
Remarks:	Hard coral mostly dead. Soft coral cover extensive. Obvious damage by starfish.						
Green 6.11.70	IP	N.W. side, reef flat	0-3	5,000	Nil	S	H
Remarks:	Coral destruction almost total. Soft coral cover extensive. Obvious starfish destruction of corals.						
Green 6.11.70		S.W. side, seaward slope	0-15	5,000	Nil	S	H
Remarks:	Coral destruction almost total. Mostly dead coral rubble plus algal covered coral skeletons in situ.						
Green 6.11.70	IP	S.W. side, seaward slope	0-15	5,000	Nil	S-M	H
Remarks:	Extensive destruction of hard coral. Mostly dead coral rubble plus algal covered coral skeletons in situ.						

Table 1 cont'd.

Reef Date	Type	Position	Depth	Area	No. specimens	Cover	Skeletons in situ
Green 6.11.70	IP	S. side, seaward slope	0-15	5,000	Nil	M	H
Remarks:	Extensive destruction of hard corals. Mostly dead coral rubble plus algal covered coral skeletons in situ.						
Green 6.11.70	IP	S. E. side, submerged reef	3-10	10,000	Nil	M	H
Remarks:	Patches of soft coral interspersed with hard coral which had survived starfish invasion. Marked development of few species of coral.						
Flynn 5.11.70	OP	S. E. side, seaward slope	0-15	1,500	1 J near reef crest	M	L
Remarks:	Hard coral cover extensive but many colonies stunted.						
Flynn 5.11.70	OP	N. W. side, back reef area	0-10	10,000	15 A hiding under plate corals	D	L
Remarks:	Hard coral growth luxuriant. Starfish present but not conspicuous.						
Thetford 2.5.70	IP	S. E. side, seaward slope	0-10	2,000	Nil	M-D	L
Remarks:	Hard coral growth luxuriant. No damage by starfish.						
Thetford 2.5.70	IP	S. tip, seaward slope	0-5	5,000	Nil	M	L
Remarks:	Hard corals well developed. No damage by starfish.						

Table 1 cont'd.

Milln 4.11.70	OP	Right around perimeter, seaward slopes	0-15	40,000	Nil	D	L
Remarks:	Hard coral growth luxuriant particularly on lee side. No starfish seen and no damage attributable to starfish observed.						
Moore 2.5.70	IP	S.W. tip, back reef area	0-5	2,000	5A on vertical faces of bombies	M-D	L-M
Remarks:	Corals on tops of bombies alive. Corals on sides of bombies damaged by starfish.						
Pellowe 4.11.70	OP	W. side, seaward slope	0-10	3,000	Nil	M-D	L
Remarks:	Hard corals well developed. Brain corals conspicuous. No damage by starfish.						
North West 4.11.70	OP	Middle, submerged reef	5-10	1,000	Nil	M	L
Remarks:	Hard corals patchy but well developed. No damage by starfish.						
Channel 4.11.70	OP	S. tip, seaward slope	0-5	5,000	Nil	M	L
Remarks:	Hard corals well developed. Few soft corals seen. No damage by starfish.						
Channel 4.11.70	OP	N. tip, seaward slope	0-5	5,000	Nil	M	L
Remarks:	Hard corals well developed. Few soft corals seen. No damage by starfish.						
Sudbury 2.5.70	IP	N.W. side, seaward slope	0-5	10,000	Nil	S-M	H
Remarks:	Obvious starfish damage. Few corals had survived.						

Table 1 cont'd.

Reef Date	Type	Position	Depth	Area	No. specimens	Cover	Skeletons *in situ*
Sudbury 6.11.70	IP	N.W. of cay, reef flat	0-3	10,000	Nil	S	H
Remarks:	Coral destruction appeared total. Much coral rubble. Soft coral cover extensive.						
Sudbury 6.11.70	IP	W. side, seaward slope	0-10	7,000	Nil	M	H
Remarks:	Massive destruction of hard corals. Obvious damage by starfish. Dark algae on coral skeletons remaining *in situ*.						
Noggin 3.11.70	OP	S.E. tip, seaward slope	0-15	5,000	Nil	M	L
Remarks:	Some coral damage not obviously caused by starfish. Hard coral patchy.						
Noggin 3.11.70	OP	N. tip, seaward slope	0-10	5,000	Nil	M	L
Remarks:	Hard coral patchy, No damage attributable to starfish.						
Flora 7.11.70	IP	S.E. side, seaward slope	0-5	10,000	Nil	M	H
Remarks:	Coral destruction almost total. Black algal covered coral skeletons.						
Flora 7.11.70	IP	S.W. side, seaward slope	0-5	7,000	Nil	S	H
Remarks:	Coral destruction almost total. Black algal covered coral skeletons. Few soft corals.						
Hedley 3.11.70	OP	S.E. tip, seaward slope	0-15	10,000	Nil	M	L
Remarks:	Patchy damage to hard corals near reef crest.						

Table 1 cont'd.

Hedley 3.11.70	OP	N.E. tip, seaward slope	0-15	10,000	Nil	M	L
Remarks:	Patchy damage to hard coral near reef crest.						
Gibson 3.11.70	IP	S.E. side seaward slope	0-10	5,000	Nil	S-M	H
Remarks:	Extensive destruction of hard corals. Soft corals common.						
McCulloch 3.11.70	IP	W. side, seaward slope	0-5	3,000	Nil	S-M	H
Remarks:	Massive destruction of hard corals. Coral skeleton *in situ* covered with black algae. Soft corals common.						
McCulloch 3.11.70	IP	N.E. tip, seaward slope	0-15	5,000	Nil	M	H
Remarks:	Massive destruction of hard corals. Coral skeletons *in situ* covered with black algae. Soft corals common.						
Howie 1.5.70	IP	S. tip, lagoon bombie	0-5	500	Nil	M	H
Remarks:	Extensive destruction of coral by starfish. Soft corals common. Water turbid.						
Howie 2.11.70	IP	W. side, lagoon near centre of reef	0-5	500	Nil	S	H
Remarks:	Coral destruction appeared to be total. Water turbid.						
Cayley 2.11.70	IP	S.W. tip, seaward slope	0-10	2,000	Nil	M	M
Remarks:	Large *Porites* common and most had survived starfish invasion of reef.						
Cayley 2.11.70	IP	W. side, seaward slope	0-10	5,000	Nil	M	M
Remarks:	Small clumps of coral had survived starfish invasion.						

Table 1 cont'd.

Reef Date	Type	Position	Depth	Area	No. specimens	Cover	Skeletons in situ
Peart 23.9.69	IP	S.W. side, back reef area	0-2	24,000	Nil	S-M	H
Remarks:	Massive destruction of hard corals. Some corals regenerating.						
Feather 22.9.69	IP	N. tip, crest and reef flat	0-1	4,000	Nil	S	H
Remarks:	Extensive destruction of hard corals by starfish. Soft coral cover extensive.						
Feather 22.9.69	IP	N. tip, back reef area	0-5	5,000	Nil	S	H
Remarks:	Soft corals abundant. Hard corals obviously killed by starfish.						
Feather 23.9.69	IP	E. side, seaward slope	0-5	4,000	Nil	S-M	H
Remarks:	Soft coral cover extensive. Hard corals obviously killed by starfish.						
Feather 23.9.69	IP	S. tip, seaward slope	0-5	10,000	Nil	M	H
Remarks:	Extensive destruction of hard corals. Soft coral cover extensive.						
Feather 2.11.70	IP	N. tip, seaward slope	0-12	5,000	Nil	S-M	H
Remarks:	Extensive destruction of hard corals. Soft coral cover extensive.						
Feather 2.11.70	IP	E. side, seaward slope	0-12	5,000	Nil	M	H
Remarks:	Coral destruction extensive. Soft coral cover extensive.						

Table 1 cont'd.

Feather 2.11.70	IP	E. side, seaward slope	0-12	5,000	Nil	S-M	H
Remarks:	Massive destruction of hard corals. Soft coral cover extensive.						
Feather 2.11.70	IP	E. side, seaward slope	0-12	5,000	Nil	M	H
Remarks:	Massive destruction of hard corals. Soft coral cover extensive.						
Nathan 26.9.69	OP	E. side, seaward slope	0-10	26,000	Nil	D	L
Remarks:	Hard coral growth luxuriant. No damage caused by starfish.						
Nathan 26.9.69	OP	Middle, reef flat	0-2	18,000	Nil	M	L
Remarks:	Hard corals well developed. No damage caused by starfish.						
Nathan 26.9.69	OP	N.W. side, bombie in lee	0-5	8,000	700 small J. collected in 2 hrs. from coral on top and sides of bombie	S-M	M
Remarks:	Mostly Acropora under attack.						
Nathan 27.1.70	OP	N.W. side, bombie in lee	0-10	10,000	182 J seen in 20 mins. on top and sides of bombie	S-M	M
Remarks:	Mostly Acropora under attack.						
Gilbey 25.9.69	OP	E. side, seaward slope	0-20	14,000	Nil	D	L
Remarks:	Hard coral growth luxuriant.						
Gilbey 25.9.69	OP	W. side, lagoon edge	0-10	12,000	Nil	S-M	L
Remarks:	Some coral destruction but corals had been dead for long time. Suspected storm damage.						
Hall-Thompson 24.5.71	IP	S. side, lagoon	0-10	10,000	Nil	M	H
Remarks:	Massive destruction of hard corals. Estimated 30% soft coral cover.						

Table 1 cont'd.

Reef Date	Type	Position	Depth	Area	No. specimens	Cover	Skeletons in situ
Hall-Thompson 24.5.71	IP	E. side, seaward slope	0-15	5,000	Nil	M-D	H
Remarks:	Massive destruction of hard corals from reef crest to sea floor. Estimated 15% soft coral cover.						
Adelaide 24.5.71	IP	Middle N. side lagoon	0-6	10,000	Nil	S-M	H
Remarks:	Dead corals in situ. Coral destruction appeared to be almost total.						
Adelaide 24.5.71	IP	N.E. tip, seaward slope	0-15	7,000	Nil	M	H
Remarks:	Extensive destruction of coral. Dead corals in situ mostly massive species. Acropores broken up.						
Potter 25.9.69	OP	Middle E. side, seaward slope	0-10	12,000	Nil	M-D	L
Remarks:	Hard corals well developed.						
Potter 25.9.69	OP	Middle of reef, lagoon	0-5	10,000	1 A on vertical face of bombie. 1 J on brain coral	M	L-M
Remarks:	Some coral damage possibly due to storms.						
Potter 24.5.71	OP	Middle of reef, lagoon	0-10	10,000	Nil	M	H
Remarks:	Destruction of coral almost total. Damage obviously caused by starfish.						

Table 1 cont'd.

Potter 24.5.71	OP	N.E. side, seaward slope	0-20	15,000	1 A near crest	M-D	L
Remarks:	No damage obviously caused by starfish.						
Ellison 28.5.71	IP	S.W. side, back reef area	3-10	10,000	1 J on dead coral	M-D	H
Remarks:	Destruction of massive and branching corals almost total.						
Eddy 28.12.70	IP	W. side, seaward slope	0-3	5,000	1 A on rubble	M	H
Remarks:	Destruction of hard coral almost total. Much rubble among dead skeletons in situ. Some regeneration of Acropora and Pocillopora tips.						
Eddy 28.12.70	IP	S. tip, seaward slope	0-10	5,000	Nil	M-D	H
Remarks:	A few large Porites had survived.						
Farquharson 12.12.69	IP	N. side, seaward slope	0-5	5,000	Nil	M	H
Remarks:	Coral mostly dead. Obvious damage caused by starfish.						
Farquharson 28.5.71	IP	S.E. corner, seaward slope	0-15	7,000	Nil	M	M-H
Remarks:	Obvious damage by starfish. Some corals missed by starfish, others partially eaten but regenerating.						
Taylor 28.9.69	IP	S. side of cay, reef flat	0-2	16,000	68 A on hard corals seen in 20 minutes	M	H
Remarks:	Destruction of corals almost total. Dead corals mostly acropores.						
Taylor 28.9.69	IP	W. side of cay, reef flat	0-1	8,000	30 A and J eating soft coral	S	H
Remarks:	Destruction of corals almost total. Soft corals common.						

Table 1 cont'd.

Reef Date	Type	Position	Depth	Area	No. specimens	Cover	Skeletons *in situ*
Taylor 28.9.69	IP	Middle of lagoon, bombies	0-5	6,000	1-2 A per bombie found on sides of bombies	S-M	M-H
Remarks:	Massive corals mostly undamaged.						
Taylor 28.1.70	IP	S. of cay, reef flat	0-2	10,000	2 A on hard coral	S-M	H
Remarks:	Destruction of corals almost total. Dead acropores had been smashed since previous visit.						
Taylor 30.12.70	IP	N.W. side, lagoon near cay	0-3	15,000	1 A, 3 J on soft corals	S	H
Remarks:	Coral destruction almost total. A few living clumps of *Pocillopora* seen. Extensive soft coral cover.						
Taylor 31.12.70	IP	N. side, seaward slope	0-5	20,000	Nil	S	H
Remarks:	Extensive coral destruction. Some large *Porites* and a few coral colonies on tops of coral pinnacles had survived.						
Taylor 31.12.70	IP	S. side, seaward slope	0-15	15,000	2 J on crest	D	M
Remarks:	Corals on exposed reef crest had survived. Corals dead from 3-4 metres below crest to sea floor.						
Taylor 1.1.71	IP	S.W. tip, lagoon	0-5	30,000	2 A on *Acropora*	S-M	H
Remarks:	Coral destruction almost total. Recent starfish feeding scars on surviving corals.						

Table 1 cont'd.

Taylor 1.1.71	IP	E. side, lagoon	0-5	15,000	20 A collected from sides of 10 bombies	S-M	H
Remarks:	Coral destruction appeared total.						
Taylor 25.5.71	IP	W. side, lagoon near cay	0-6	10,000	10 J on soft corals	S	H
Remarks:	Coral destruction appeared total.						
Beaver 23.9.69	IP	E. of cay, reef flat	0-2	12,000	70 A in 20 minutes on Acropora	M	M-H
Remarks:	Extensive coral destruction. Soft corals common.						
Beaver 23.9.69	IP	N. of cay reef flat	0-5	10,000	25 A seen in 20 minutes on reef flat and tops of bombies	M	M-H
Remarks:	Coral under attack by starfish. Soft corals common.						
Beaver 29.12.70	IP	W. of cay, seaward slope	0-10	10,000	Nil	S	H
Remarks:	Coral destruction almost total. Extensive soft coral cover. Some regeneration of tips of staghorn coral.						
Beaver 29.12.70	IP	N.E. tip, seaward slope	0-15	10,000	Nil	D	M-H
Remarks:	Clumps of corals on tops of coral pinnacles survived.						
"Yamacutta"* 2.1.71	IP	N. side, seaward slope	0-3	5,000	Nil	S	H
Remarks:	Some Pocillopora colonies had survived but most corals were dead.						
"Yamacutta" 2.1.71	IP	Centre of reef, lagoon bombies	0-5	10,000	4 J, 8A, at bases of staghorn corals	M	L
Remarks:	Starfish feeding on staghorn Acropores. Remainder of corals untouched.						

* quotes denote that name of reef is unofficial.

Table 1 cont'd.

Reef Date	Type	Position	Depth	Area	No. specimens	Cover	Skeletons in situ
"Yamacutta" 2.1.71	IP	S. tip, seaward slope	0-15	5, 000	Nil	D	L
Remarks:	No damage caused by starfish.						
"Yamacutta" 25.5.71	IP	N. side, lagoon	0-15	10, 000	2 A on sides of bombies	M	H
Remarks:	Extensive coral destruction. Live coral confined to tops of bombies.						
"Yamacutta" 25.5.71	IP	N. E. tip, seaward slope	0-15	15, 000	Nil	M	M-H
Remarks:	Corals in upper 3 metres mostly alive; mostly dead in deeper water.						
"Yamacutta" 25.5.71	IP	E. side, seaward slope	0-20	500	Nil	M	H
Remarks:	Coral destruction apparently total.						
"Yamacutta" 25.5.71	IP	E. side, seaward slope	0-20	500	Nil	M	M-H
Remarks:	Patchy destruction of corals on upper 6 metres of reef. Below this region destruction almost total.						
"Yamacutta" 25.5.71	IP	S. E. side, seaward slope	0-20	5, 000	Nil	M	L-M
Remarks:	Slight damage in upper 15 metres of reef. Below this region coral destruction almost total.						
"Horseshoe" 25.5.71	OP	Middle W. area, lagoon	0-15	5, 000	2 A on staghorn corals	M	H
Remarks:	Coral destruction extensive. Estimated 20 per cent soft coral cover.						

Table 1 cont'd.

"Horseshoe" 25.5.71	OP	Middle E. side, seaward slope	0-15	10,000	Nil	M	L-M
Remarks:	Patches of algal covered coral skeletons in situ.						
"Judy" 26.5.71	OP	Middle lagoon	0-15	10,000	10 A on top of reef platform	M	M
Remarks:	Obvious damage caused by starfish.						
"Doll" 26.5.71	OP	Middle lagoon	0-15	7,000	12 A on top of reef platform	M	H
Remarks:	Extensive coral destruction. Obvious damage caused by starfish.						
"Trout" 15.12.69	OP	W. side, seaward slope	0-30	15,000	1 per 3 m^2 on coral in deep water around perimeter	M	M
Remarks:	Coral dead in deep water but progressively alive towards shallow water.						
"Trout" 28.1.70	OP	W. side, seaward slope	0-3	12,000	87 counted in 20 minutes	M	M
Remarks:	Branching and massive corals under attack. Starfish ascending seaward slope.						
"Trout" 26.5.71	OP	N. tip, seaward slope	0-20	15,000	50 A seen in 20 minutes on coral platforms	M-D	M
Remarks:	Branching and massive corals under attack in shallow water.						
"Trout" 26.5.71	OP	S.W. tip, seaward slope	0-20	16,000	35 A seen in 20 minutes on coral platforms	M	H
Remarks:	Coral destruction almost total. Blackish algae growing on dead coral skeletons in situ.						

Table 1 cont'd

Reef Date	Type	Position	Depth	Area	No. specimens	Cover	Skeletons in situ
"Josephine" 29.1.70	OP	W. side seaward slope	3-10	2,000	Nil	D	L
Remarks:	Hard coral growth luxuriant. Reef not exposed at low tide.						
"Zeta" 26.5.71	OP	N. side, seaward slope	0-20	50,000	25 A seen in 20 minutes on upper region of slope	M	M-H
Remarks:	Massive and branching corals under attack. Coral in deeper water eaten.						
Otter 13.12.69	IP	N. side, back reef area	0-3	5,000	12 A seen near tops of bombies	S	H
Remarks:	Massive destruction of coral. Patches of soft coral on rubble strewn bottom.						
Otter 13.12.69	IP	Middle back reef area	0-3	10,000	1 A per 10 m^2 on tops of squat bombies	M	H
Remarks:	Massive destruction of coral. Coral obviously killed by starfish.						
"Big Sand Cay" 15.12.69	OP	N. side of cay, seaward slope	0-10	5,000	Nil	M	M
Remarks:	Coral probably killed by shifting sand of cay.						
"Big Sand Cay" 26.5.71	OP	W. side, back reef area	0-15	25,000	128 A per 20 minutes on coral in shallow water	M	M-H
Remarks:	Coral in water deeper than 3 metres almost all dead. Starfish attacking corals in shallow water.						
"Glenda" 27.5.71	OP	W. side seaward slope	0-20	5,000	42 A per 20 minutes on coral in shallow water	M-D	M
Remarks:	Extensive but patchy destruction of corals in water deeper than 3 metres. Starfish attacking corals on reef flat.						

Table 1 cont'd.

"Seeker" 27.5.71	OP	S.E. side, seaward slope	0-20	10,000	38 A per 20 minutes on coral in shallow water	D	M
Remarks:	Coral destruction in swathes from deep water to reef flat obviously caused by starfish.						
"Birthday" 14.12.69	OP	S. tip, crest and seaward slope	0-10	15,000	6 J seen on crest	D	L
Remarks:	Hard corals well developed.						
Britomart 13.12.69	IP	N. tip, seaward slope	0-10	10,000	Adults abundant on coral in shallow water but not counted	M	H
Remarks:	Massive coral destruction obviously caused by starfish.						
Pith 15.12.69	OP	S. tip, seaward slope	0-10	5,000	Nil	D	L
Remarks:	Hard corals well developed.						
Trunk 14.12.69	IP	S.W. corner, seaward slope	0-10	20,000	Abundant but cryptic and not counted - on coral in shallow water	M	L-M
Remarks:	Coral under attack by starfish. White coral skeletons exposed.						
Bramble 13.12.69	IP	S. tip, seaward slope	0-10	25,000	Abundant but not counted - on coral in shallow water	D	M-H
Remarks:	Extensive coral destruction. Starfish in plague proportions.						

Table 1 cont'd.

Reef Date	Type	Position	Depth	Area	No. specimens	Cover	Skeletons *in situ*
Bramble 14.12.69	IP	W. side, lagoon	0-3	2,000	100 collected in 1 hour from corals on edge of lagoon	D	H
Remarks:	Extensive coral destruction. Large areas of freshly killed coral and very large numbers of starfish present.						
Slashers No. 1 29.7.70	IP	W. of cay, reef flat	0-2	25,000	Abundant on branching and massive corals	M	M-H
Remarks:	Starfish densely packed over thousands of square metres of reef flat.						
Slashers No. 1 17.8.70	IP	W. of cay, reef flat	0-2	80,000	Abundant, frequently over-lapping - on branching and massive corals	M	M-H
Remarks:	Starfish densely packed over thousands of square metres of reef flat.						
Slashers No. 1 30.10.70	IP	W. of cay, reef flat	0-2	45,000	134 per 20 minutes on branching and massive corals	M	H
Remarks:	Destruction of hard corals almost total. Coral skeletons covered with dark algae.						
Slashers No. 2 27.1.71	IP	W. side, reef flat	0-2	70,000	2 A on hard coral	S-M	H
Remarks:	Coral destruction almost total. Coral skeletons covered with black algae.						

Table 1 cont'd.

Slashers No. 2 27.1.71	IP	E. side, reef flat	0-3	130,000	Nil	S	H
Remarks:	Coral destruction almost total. Coral skeletons covered with black algae.						
Slashers No. 3 27.1.71	IP	W. side, reef flat	0-2	120,000	Nil	S-M	H
Remarks:	Destruction of hard corals almost total. Coral skeletons covered with dark algae.						
Slashers No. 3 27.1.71	IP	W. side, bombies in back reef area	0-10	80,000	2 A on vertical faces of bombies	S	H
Remarks:	Destruction of hard corals almost total. Coral skeletons covered with dark algae.						
Slashers No. 4 27.1.71	IP	W. side, reef flat	0-2	30,000	65 A per 20 minutes on coral of all types	S	M
Remarks:	Starfish attacking branching and massive corals.						
Slashers No. 4 27.1.71	IP	W. side, crest	0-2	2,000	107 J collected from low acropores	S	M
Remarks:	Juvenile starfish among acropores on crest.						
Dip 30.7.70	OP	Middle E. side, seaward slope	0-20	7,000	20 A seen in deeper parts of reef slopes around periphery of reef	M	L
Remarks:	Corals in deep water under attack.						
Coil 30.7.70	OP	Middle E. side, seaward slope	0-20	7,000	12 A seen in deeper parts of reef slopes	M-D	L
Remarks:	Corals in deep water under attack.						

Table 1 cont'd.

Reef Date	Type	Position	Depth	Area	No. specimens	Cover	Skeletons *in situ*
Glow 31.7.70	OP	Middle E. side, seaward slope	0-20	10,000	60 specimens seen on low acropores	M	L-M
Remarks:	Coral stunted, some damage caused by starfish.						
Glow 31.7.70	OP	N. W. side, back reef area	0-10	5,000	40 specimens seen on coral on sides of bombies	S-M	L-M
Remarks:	Coral damage patchy but obviously due to starfish.						
Glow 30.10.70	OP	S. E. side, seaward slope	0-15	20,000	118 A seen in 20 minutes on all types of coral.	M	M-H
Remarks:	Hard corals in deep water mostly dead. Skeletons *in situ*.						
Glow 28.1.71	OP	S. E. side, seaward slope	0-10	10,000	14 J and 94 A seen in 20 minutes on coral near crest	M	H
Remarks:	Hard corals mostly dead from sea floor to crest. Corals on crest being attacked.						
Glow 28.1.71	OP	N. W. side, coral pinnacles	0-5	10,000	15A per 20 minutes on coral near tops of coral pinnacles	S-M	H
Remarks:	Hard corals mostly dead. Few live coral colonies on tops of pinnacles.						
Bowl 30.10.70	OP	S. E. side, seaward slope	0-30	10,000	Nil	S-M	L
Remarks:	Hard corals stunted but showing no obvious signs of recent damage. Below 24 metres sponges and gorgonians were common.						

Table 1 cont'd.

Bowl 30.10.70	OP	Middle of reef lagoon	0-5	5,000	1 J on top of coral pinnacle	S	L
Remarks:	Hard corals stunted and patchy. Some corals damaged possibly by juvenile starfish.						
"Grub" 25.5.70	IP	S. tip, back area	0-10	4,000	15 A seen on sides of bombies	S	L
Remarks:	Starfish present but little coral damage.						
"Grub" 18.8.70	IP	N. tip, seaward slope	0-20	10,000	26 A counted on vertical and near vertical faces of reef	M	L-M
Remarks:	Hard corals well developed. Some coral damage obviously caused by starfish.						
"Grub" 29.1.71	IP	E. side, seaward slope	0-15	10,000	526 A seen in 20 minutes on vertical and near vertical reef faces near reef edge	M	M
Remarks:	Large amounts of freshly killed hard corals noted. Most of the remaining live coral under attack.						
John Brewer 29.1.70	IP	N. W. side, seaward slope	0-15	120,000	36 A seen in 20 minutes on corals growing on vertical and near vertical faces	D	L
Remarks:	Corals mostly tabular acropores. Obvious damage by starfish to corals in deeper water.						
John Brewer 29.1.70	IP	N. W. side, reef flat	0-2	20,000	Nil	S	L
Remarks:	Coral cover patchy. No damage by starfish observed.						
John Brewer 28.7.70	IP	W. side, seaward slope	0-10	3,000	Common but not counted - on corals growing on vertical and near vertical faces.	M	H
Remarks:	Coral destruction heavy and continuing.						

Table 1 cont'd.

Reef Date	Type	Position	Depth	Area	No. specimens	Cover	Skeletons *in situ*
John Brewer 16.8.70	IP	W. side, seaward slope	0-5	3,000	2 A seen on coral near crest	M	H
Remarks:	Corals in deeper water mostly dead. Corals in shallow water under attack.						
John Brewer 26.1.71	IP	S.E. side seaward slope	0-15	100,000	5 A on vertical faces and reef crest	M	H
Remarks:	Most corals on reef crest had survived but almost all corals in deeper water except massive *Porites* and *Astreopora* had been killed.						
John Brewer 26.1.71	IP	E. side, seaward slope	0-15	10,000	4 A on vertical faces and 3 J on reef crest	M	H
Remarks:	Most coral colonies on reef crest had survived. Corals in deeper water had been killed.						
John Brewer 26.1.71	IP	W. tip, seaward slope	0-15	5,000	7 A seen in 20 minutes on vertical and near vertical faces of reef	M	H
Remarks:	Most coral colonies on reef crest had survived. Corals in deeper water mostly killed						
John Brewer 26.1.71	IP	N.W. side, seaward slope	0-15	5,000	Nil	M	H
Remarks:	Most coral colonies on reef crest had survived. Corals in deeper water mostly dead.						
Lodestone 29.1.70	IP	W. side, seaward slope	0-5	10,000	18 A seen in 20 minutes on vertical and near vertical faces	M	L
Remarks:	Mostly tabular acropores on vertical and near vertical faces. Corals under attack in deeper water.						

Table 1 cont'd.

Lodestone 29.5.70	IP	N. tip, seaward slope	0-5	40,000	132 A seen in 20 minutes on vertical and near vertical faces	M	M
Remarks:	Mostly tabular acropores on vertical and near vertical faces. Coral under attack in deeper water.						
Lodestone 31.10.70	IP	E. side, seaward slope	0-15	30,000	12 A seen in 20 minutes on dead coral	M	H
Remarks:	Coral near crest mostly alive. Remainder of coral on slope mostly dead.						
Lodestone 31.10.70	IP	S.E. side, seaward slope	0-10	3,000	Nil	M	H
Remarks:	Coral near crest alive, remainder mostly dead.						
Lodestone 31.10.70	IP	S. side, seaward slope	0-15	3,000	3 A seen in 20 minutes on dead coral	M	H
Remarks:	Coral near crest alive, the remainder mostly dead.						
Lodestone 31.10.70	IP	S.W. side, seaward slope	0-10	3,000	7 A seen in 20 minutes on vertical faces of reef	M	H
Remarks:	Only coral in shallow water alive, remainder mostly dead.						
Lodestone 31.10.70	IP	N.W. side back reef area	0-10	9,000	22 A seen in 20 minutes on tops of bombies	M	M-H
Remarks:	Coral on tops of bombies mostly alive, remainder mostly dead.						
"Dolphin" 29.10.70	OP	N. tip, seaward slope	0-15	10,000	14 A seen in 20 minutes in deep water on slopes	S-M	L
Remarks:	Some recent damage to hard corals by starfish in deeper water on seaward slopes.						
"Dolphin" 29.10.70	OP	N.W. side, reef flat	0-2	3,000	Nil	S	L
Remarks:	Some coral damage but cause not ascertained.						

Table 1 cont'd.

Reef Date	Type	Position	Depth	Area	No. specimens	Cover	Skeletons in situ
"Centipede" 25.5.70	IP	Middle of lagoon	0-3	10,000	2 A on sides of bombie	S	L
Remarks:	Hard corals stunted.						
"Centipede" 19.8.70	IP	N. tip, seaward slope	0-20	3,000	Nil	S-M	L
Remarks:	No damage caused by starfish observed.						
"Centipede" 27.1.71	IP	Centre of lagoon	0-10	10,000	4 A on vertical and near vertical faces of reef	S	L
Remarks:	Hard corals stunted and patchy. Some fresh damage due to starfish.						
"Centipede" 27.1.71	IP	S. side, seaward slope	0-15	100,000	12 A on coral in deep water	S-M	L
Remarks:	Corals somewhat stunted. Some damage apparently due to starfish in deep water.						
Keeper 30.1.70	IP	N. tip, seaward slope	0-5	5,000	80 A seen in 20 minutes on coral on vertical and near vertical faces of reef	M	L-M
Remarks:	Coral in deeper water dead. Starfish ascending slope.						
"Watkins" 18.8.70	IP	N. tip, seaward slope	0-20	7,500	Nil	M	L
Remarks:	No damage caused by starfish observed.						
"Watkins" 18.8.70	IP	N. tip, back reef area	0-5	5,000	Nil	M	L
Remarks:	Some coral damage but cause not ascertained.						

Table 1 cont'd.

"Watkins" 29.10.70	IP	N. E. side, seaward slope	0-15	27,000	Nil	D	L
Remarks:	Coral growth luxuriant.						
"Watkins" 29.10.70	IP	W. side, bombies in back reef area	0-10	5,000	Nil	S	M
Remarks:	Coral stunted and some colonies dead. Cause of death not established.						
"Watkins" 30.1.71	IP	S.W. side, bombies in back reef area	0-10	3,000	1 A seen on side of bombie	S	L
Remarks:	Some fresh coral damage possibly caused by starfish.						
Wheeler 31.1.70	IP	N. tip, seaward slope	0-10	5,000	Nil	D	L
Remarks:	Tabular acropores well developed. No coral damage.						
Wheeler 31.1.70	IP	W. of cay, back reef area	0-5	5,000	Nil	S-M	L
Remarks:	Slight coral damage possibly due to siltation.						
Wheeler 30.1.71	IP	N. & W. sides, seaward slope	0-10	200,000	Nil	M-D	L
Remarks:	Hard coral growth luxuriant. No obvious damage to corals.						
Wheeler 30.1.71	IP	S. E. tip, seaward slope	0-20	3,000	1 A seen on coral in deep water	M	L
Remarks:	Hard coral growth luxuriant. No obvious damage observed.						
Davies 1.2.70	IP	N. tip, seaward slope	0-10	2,000	Nil	S-M	L
Remarks:	No damage caused by starfish.						

Table 1 cont'd.

Reef Date	Type	Position	Depth	Area	No. specimens	Cover	Skeletons *in situ*
"Lynch" 19.8.70	IP	N. tip, seaward slope	0-5	5,000	Nil	M	L
Remarks:	No damage attributable to starfish.						
"Lynch" 29.10.70	IP	S.W. side, seaward slope	0-10	5,000	Nil	S	M
Remarks:	Corals near crest alive but mostly dead in deeper water. Cause of death not ascertained.						
"Lynch" 30.1.71	IP	W. side, seaward slope	0-10	20,000	Nil	S	L
Remarks:	Extensive areas devoid of hard or soft corals.						
Broadhurst 1.2.70	IP	N. tip, seaward slope	0-10	10,000	Adults common on coral on vertical faces of reef	M	H
Remarks:	Extensive coral destruction. Coral on vertical faces mostly tabular acropores.						
Broadhurst 3.2.70	IP	N. tip, seaward slope	0-10	7,000	38 A collected in 20 minutes from coral on steep seaward slope	S-M	H
Remarks:	Extensive coral destruction. Coral on seaward slope of reef mostly tabular acropores.						
Broadhurst 20.8.70	IP	N. tip, reef crest	0-1	5,000	6 A seen in 20 minutes on coral near crest	D	L
Remarks:	Hard coral well developed on crest and showing little starfish damage.						

Table 1 cont'd.

Broadhurst 31.1.71	IP	S. E. side, seaward slope	0-10	2,000	Nil	S	L
Remarks:	Coral sparse but undamaged.						
Broadhurst 31.1.71	IP	W. side, seaward slope	0-10	2,000	Nil	S	L
Remarks:	Coral sparse but undamaged.						
Broadhurst 31.1.71	IP	N. side, seaward slope	0-10	14,000	32 A seen in 20 minutes	M	H
Remarks:	Most of hard coral from sea floor to crest has been killed by starfish.						
"Elaine" 20.8.70	IP	N. tip, seaward slope	0-20	7,000	Nil	D	L
Remarks:	Hard coral well developed. No damage obviously caused by *A. planci*.						
Shrimp 28.10.70	IP	W. side, lagoon	0-5	8,000	Nil	S	L
Remarks:	Hard corals sparse and stunted. Sponges abundant. No damage obviously caused by *A. planci*.						
Castor 21.8.70	IP	N. tip, seaward slope	0-10	11,000	Nil	M	L
Remarks:	Some coral damage probably due to storms.						
Pollux 21.8.70	IP	Middle W. side, seaward slope	0-10	12,000	4 A on coral on sides of bombies	M	L-M
Remarks:	Patches of coral damage caused by starfish.						
Prawn 2.2.70	IP	Middle E. side, seaward slope	0-10	70,000	Nil	M-D	L
Remarks:	Coral growth luxuriant.						

Table 1 cont'd.

Reef Date	Type	Position	Depth	Area	No. specimens	Cover	Skeletons *in situ*
Prawn 28.10.70	IP	Middle E. side, seaward slope	0-10	15,000	Nil	M	L
Remarks:	Hard corals well developed. Large massive corals prominent. No obvious damage caused by starfish.						
Prawn 28.10.70	IP	W. side, pinnacles in lee	0-5	5,000	Nil	S	L
Remarks:	Hard corals well developed in patches. No obvious damage caused by starfish.						
Bowden 3.2.70	IP	N. tip, seaward slope	0-10	30,000	Nil	S-M	L
Remarks:	Coral undamaged but stunted.						
Mid 22.8.70	IP	Middle E. side, seaward slope	0-20	13,000	3 A on corals in deep water	M	L
Remarks:	Coral damage patchy and obviously caused by starfish.						
Shell 28.10.70	IP	S.E. side, seaward slope	0-10	7,000	Nil	M	L
Remarks:	Hard corals well developed. Staghorn corals abundant in deeper water.						
Shell 28.10.70	IP	N.W. side, lagoon	0-2	3,000	Nil	S	L
Remarks:	Hard corals well developed in patches. No damage obviously caused by *A. planci.*						
Tabias 21.8.70	IP	Middle W. side, back reef area	0-10	5,000	6 A seen on coral on sides of bombies	S	L
Remarks:	Some patchy coral damage obviously caused by starfish.						

Table 1 cont'd.

"Hades" 28.10.70	IP	W. side, lagoon	0-2	1,000	Nil	S	L
Remarks:	Hard corals well developed in patches. Soft corals and sponges common.						
"Yamato" 22.8.70	IP	Middle E. side, seaward slope	0-20	15,000	5 A seen on coral in deep water around perimeter	M	L
Remarks:	Hard corals well developed. Damage to corals patchy but obviously caused by starfish.						
Tiger 27.10.70	IP	N. E. side, seaward slope	0-10	14,000	5 A seen on corals in deep water around perimeter	M-D	L
Remarks:	Hard corals luxuriant but some recent damage caused by starfish apparent.						
Tiger 27.10.70	IP	W. side, back reef area	0-2	6,000	Nil	S	L
Remarks:	Hard coral colonies well developed in patches.						
Darley 26.5.70	IP	N. tip, back reef area	0-10	150,000	Nil	S-M	L
Remarks:	Coral stunted but undamaged.						
Jacqueline 27.10.70	OP	E. side, seaward slope	0-10	12,000	Nil	S	L
Remarks:	Hard corals stunted and showing patchy distribution. No damage obviously caused by *A. planci.*						
Jacqueline 27.10.70	OP	W. side, back reef area	0-5	10,000	Nil	S	L
Remarks:	Hard corals stunted. Soft corals and sponges common.						

Table 1 cont'd.

Reef Date	Type	Position	Depth	Area	No. specimens	Cover	Skeletons *in situ*
Elizabeth 26.10.70	OP	S.E. side, seaward slope	0-15	10,000	1 A on coral near crest	M	L
Remarks:	Hard corals well developed. No damage obviously caused by *A. planci*.						
Elizabeth 26.10.70	OP	W. side, reef flat	0-2	8,000	Nil	S	L
Remarks:	Hard coral colonies well developed in patches. Soft corals and sponges common.						
Old 31.1.71	IP	W. side, seaward slope	0-10	10,000	Nil	S-M	L
Remarks:	Hard corals stunted but showing little damage. No damage obviously caused by *A. planci*.						
Old 31.1.71	IP	Middle of back reef area	0-5	2,000	Nil	S	L
Remarks:	Hard corals stunted. Soft corals and sponges common.						
Old 1.2.71	IP	E. side, seaward slope	0-10	15,000	Nil	S-M	L
Remarks:	Hard corals well developed in patches.						

TABLE 2. **POSITION OF TRANSECTS AND DATA ON REEF COVER OBTAINED FROM QUADRAT SAMPLING.**

Reef and date examined	Type	Position of transect	Number of quadrat prints	% LHC* cover (mean)	% DHC** cover (mean)	% total hard coral cover (mean)	Number colonies per print (mean)	% DHC in total hard coral cover (mean)	% SC+ cover (mean)	% ADS++ (mean)
Flynn 5.11.70	OP	N.W. side, back reef area	11	15.4	1.0	16.4	6.0	5.9	9.1	74.5
Thetford 2.5.70	IP	S.E. side, seaward slope	16	22.7	1.6	24.3	5.8	6.4	7.2	68.5
Moore 2.5.70	IP	S. tip, back reef area	11	8.9	9.3	18.2	4.0	51.3	32.0	49.8
Channel 4.11.70	OP	S. tip, seaward slope	9	24.1	0.7	24.8	7.2	2.7	4.9	70.3
Channel 4.11.70	OP	N. tip, seaward slope	10	10.7	0.7	11.4	5.5	6.5	3.6	84.9
Potter 24.5.71	OP	N.E. side, seaward slope	13	47.2	2.1	49.3	9.6	4.2	4.0	46.7
Farquharson 28.5.71	IP	S.E. side, seaward slope	20	16.0	10.1	26.1	2.5	38.8	20.1	54.0

* LHC = Live hard coral.
** DHC = Dead hard coral.
+ SC = Soft coral.
++ ADS = Algal dominated substratum.

Table 2 cont'd.

"Yamacutta" 25.5.71	IP	N. E. tip, seaward slope	7	26.2	16.4	42.6	10.0	38.5	18.6	38.9
"Horseshoe" 25.5.71	OP	Middle east side, seaward slope	10	30.2	15.6	45.8	4.3	34.0	3.9	50.3
"Judy" 26.5.71	OP	W. side, back reef area	15	11.9	57.2	69.1	3.7	82.8	2.7	28.3
"Doll" 26.5.71	OP	W. side, back reef area	11	7.9	61.6	69.5	3.6	88.6	4.3	23.6
"Trout" 26.5.71	OP	N. tip, back reef area	12	10.9	39.9	50.8	5.0	78.5	2.3	46.8
"Big Sand Cay" 26.5.71	OP	W. side, back reef area	21	8.4	58.3	66.7	2.8	87.5	7.3	26.0
Slashers No. 1 28.7.70	IP	E. of cay, seaward slope	4	53.6	6.9	60.5	6.0	11.4	5.8	33.7
Slashers No. 1 28.7.70	IP	E. of cay, seaward slope	6	1.7	7.0	8.7	6.3	80.0	0	91.3
Slashers No. 1 28.7.70	IP	E. of cay, seaward slope	7	46.9	3.6	50.5	9.8	7.2	2.7	46.8
Slashers No. 1 17.8.70	IP	W. of cay, reef flat	16	4.6	43.4	48.0	5.9	90.5	0	52.0

Table 2 cont'd.

Reef Date	Type	Transect	No. prints	% LHC	% DHC	% total h. c.	Colonies per print	% DHC in total h. c.	% SC	% ADS
Dip 30.7.70	OP	E. side, seaward slope	8	31.1	4.3	35.4	8.3	12.1	0	64.6
Coil 30.7.70	OP	E. side, seaward slope	4	51.5	0	51.5	9.7	0	6.3	42.2
"Grub" 18.8.70	IP	N. tip, seaward slope	10	21.4	11.0	32.4	6.0	34.0	1.9	65.7
"Grub" 29.1.71	IP	E. side, seaward slope	20	7.3	11.4	18.7	2.5	60.8	3.3	78.0
John Brewer 28.7.70	IP	W. side, seaward slope	7	6.6	56.9	63.5	5.0	89.6	0.4	36.1
John Brewer 16.8.70	IP	W. side, seaward slope	18	2.7	11.2	13.9	4.7	80.5	0.3	85.8
John Brewer 26.1.71	IP	E. side, seaward slope	3	3.0	31.8	34.8	5.6	91.3	0	65.2
John Brewer 26.1.71	IP	E. side, seaward slope	6	0	44.6	44.6	3.6	100	1.5	53.9
John Brewer 26.1.71	IP	E. side, seaward slope	6	0.7	17.9	18.6	3.3	96.2	0	81.4
Lodestone 26.7.70	IP	E. side, seaward slope	11	19.9	26.0	45.9	5.5	56.6	5.6	48.5

Table 2 cont'd.

Lodestone 26.7.70	IP	E. side, seaward slope	10	20.8	26.5	47.3	4.5	56.0	7.5	45.2
Lodestone 26.7.70	IP	E. side, seaward slope	10	2.9	49.5	52.4	3.8	94.4	0	47.6
Lodestone 26.7.70	IP	S. E. side, seaward slope	9	4.3	20.2	24.5	5.0	82.4	0.2	75.3
Lodestone 26.7.70	IP	S. E. side, seaward slope	9	14.9	22.3	37.2	5.0	59.9	1.5	61.3
Lodestone 26.7.70	IP	S. E. side, seaward slope	9	29.5	19.7	49.2	4.0	40.0	0	50.8
Lodestone 26.7.70	IP	S. E. side, seaward slope	9	24.2	27.4	51.6	3.7	53.1	0.4	48.0
Lodestone 26.7.70	IP	S. E. side, seaward slope	9	23.6	26.3	49.9	8.0	52.7	0	50.1
Lodestone 26.7.70	IP	S. E. side, seaward slope	6	12.5	31.1	43.6	6.6	71.3	0.8	55.6
Lodestone 26.7.70	IP	S. side, seaward slope	5	3.0	26.2	29.1	5.8	89.9	0	70.9
Lodestone 27.7.70	IP	W. side, seaward slope	6	16.9	30.9	47.8	8.0	64.6	1.1	51.1
Lodestone 27.7.70	IP	W. side, seaward slope	6	19.2	25.1	44.3	11.5	56.6	4.3	51.4
Lodestone 27.7.70	IP	W. side, seaward slope	8	30.3	12.9	43.2	9.0	29.9	0	56.8

Table 2 cont'd.

Reef Date	Type	Transect	No. prints	% LHC	% DHC	% total h. c.	Colonies per print	% DHC in total h. c.	% SC	% ADS
Lodestone 27.7.70	IP	W. side, seaward slope	11	16.4	8.3	24.7	7.4	33.6	0.1	75.2
Lodestone 27.7.70	IP	N. tip, seaward slope	19	29.0	23.8	52.8	13.4	42.9	0.8	46.4
Lodestone 31.10.70	IP	E. side, seaward slope	3	19.7	15.0	34.7	4.6	43.3	0	65.3
Lodestone 31.10.70	IP	E. side, seaward slope	4	0.7	38.5	39.2	3.2	98.1	14.6	46.2
Lodestone 31.10.70	IP	S. E. side, seaward slope	3	0	19.8	19.8	4.3	100	6.3	73.9
Lodestone 31.10.70	IP	S. E. side, seaward slope	3	0	47.1	47.1	4.3	100	0	52.9
Lodestone 31.10.70	IP	S. side, seaward slope	3	0.5	62.1	62.6	6.3	99.1	0	37.4
Lodestone 31.10.70	IP	S. side, seaward slope	3	1.2	43.6	44.8	6.0	97.2	8.8	46.4
Lodestone 31.10.70	IP	W. side, back reef area	2	0	37.0	37.0	5.5	100	0	63.0
"Centipede" 19.8.70	IP	N. tip, back reef area	12	12.5	2.5	15.0	6.0	16.7	0	85.0

Table 2 cont'd.

"Centipede" 19.8.70	IP	N. tip, seaward slope	7	29.0	0.9	29.9	11.0	2.9	0.6	69.5
"Watkins" 18.8.70	IP	N. tip, seaward slope	8	43.0	0.2	43.2	7.1	0.5	0.6	56.2
"Watkins" 18.8.70	IP	N. tip, back reef area	9	20.7	0.9	21.6	6.0	4.0	2.4	76.0
"Lynch" 19.8.70	IP	N. tip, back reef area	7	63.3	0.5	63.8	8.1	0.8	0.2	36.0
"Lynch" 19.8.70	IP	N. tip, back reef area	18	28.7	2.3	31.0	5.9	7.3	1.1	67.9
Broadhurst 20.8.70	IP	N. tip, seaward slope	34	3.8	19.3	23.1	5.5	83.6	0.6	76.3
Broadhurst 28.10.70	IP	N. side, seaward slope	10	31.4	8.7	40.1	6.2	21.7	0	59.9
"Elaine" 20.8.70	IP	N. tip, seaward slope	4	52.7	0	52.7	6.2	0	0	47.3
Prawn 28.10.70	IP	E. side, seaward slope	3	46.1	0	46.1	4.0	0	2.4	51.5

TABLE 3. OCCURRENCE OF CHARONIA TRITONIS

Reef	Date	Habitat	Remarks
Noggin	3.11.70	On coral, windward seaward slope of reef.	Adult. No A. planci seen in vicinity.
Noggin	3.11.70	On coral at northern tip of reef.	Juvenile. No A. planci seen in vicinity.
Nathan	26.9.69	In gutter, windward seaward slope of reef.	Adult. No A. planci seen in vicinity.
Nathan	27.1.70	Among coral on top of coral pinnacle in lee of reef.	Adult. Eating a specimen of Acanthaster planci approx. 20 cm in diameter.
Gilbey	25.9.69	In gutter on windward seaward slope of reef.	Adult. No A. planci seen in vicinity.
Gilbey	25.9.69	On coral, reef flat.	Adult. No A. planci seen in vicinity.
Potter	25.9.69	In gutter on windward seaward slope of reef.	Adult. No A. planci seen in vicinity.
Taylor	1.1.71	On coral, windward seaward slope. Water 2 m deep.	Adult. Eating Holothuria leucospilota. No A. planci in immediate vicinity.
Taylor	1.1.71	On coral, windward seaward slope. Water 5 m deep.	Adult. Eating brown holothurian. No A. planci in immediate vicinity.
Taylor	1.1.71	Under coral, windward seaward slope of reef. Water 6 m deep.	Adult. No A. planci seen in immediate vicinity.
Taylor	25.5.71	On soft coral in water 2 m deep near cay	Juvenile. Numerous small specimens of A. planci in vicinity.

Table 3 cont'd.

"Yamacutta"	2.1.71	Exposed on top of coral pinnacle in 2 m water in lagoon.	Adult. *A. planci* in vicinity.
"Horseshoe"	25.5.71	On top of submerged coral pinnacle in lagoon.	Adult. *A. planci* vicinity.
"Trout"	15.12.69	On coral on platform in lee of reef.	Adult. *A. planci* in vicinity.
"Trout"	29.1.70	Among coral on platform in lee of reef.	Adult. Eating a specimen of *A. planci* estimated to be 18 cm in diameter.
Bramble	14.12.69	On plate coral.	Adult. Eating *A. planci* about 30 cm in diameter.
John Brewer	26.1.71	Exposed on top of coral pinnacle out from windward side of reef. Water about 3 m deep.	Adult. No *A. planci* seen in immediate vicinity.
John Brewer	26.1.71	Exposed on top of coral pinnacle out from windward seaward slope of reef.	Adult. No *A. planci* seen in immediate vicinity.
Lodestone	29.5.70	In small cave on seaward slope, lee side of reef. Water about 3 m deep.	Adult. Eating specimen of *A. planci* about 22 cm in diameter.
Lodestone	31.10.70	On platform, windward seaward slope on reef.	Adult. Eating specimen of *A. planci* estimated to be 18 cm in diameter.
Glow	28.1.71	In cave in coral pinnacle in lagoon.	Adult. Recently killed. Flesh putrefying. Cause of death not apparent.

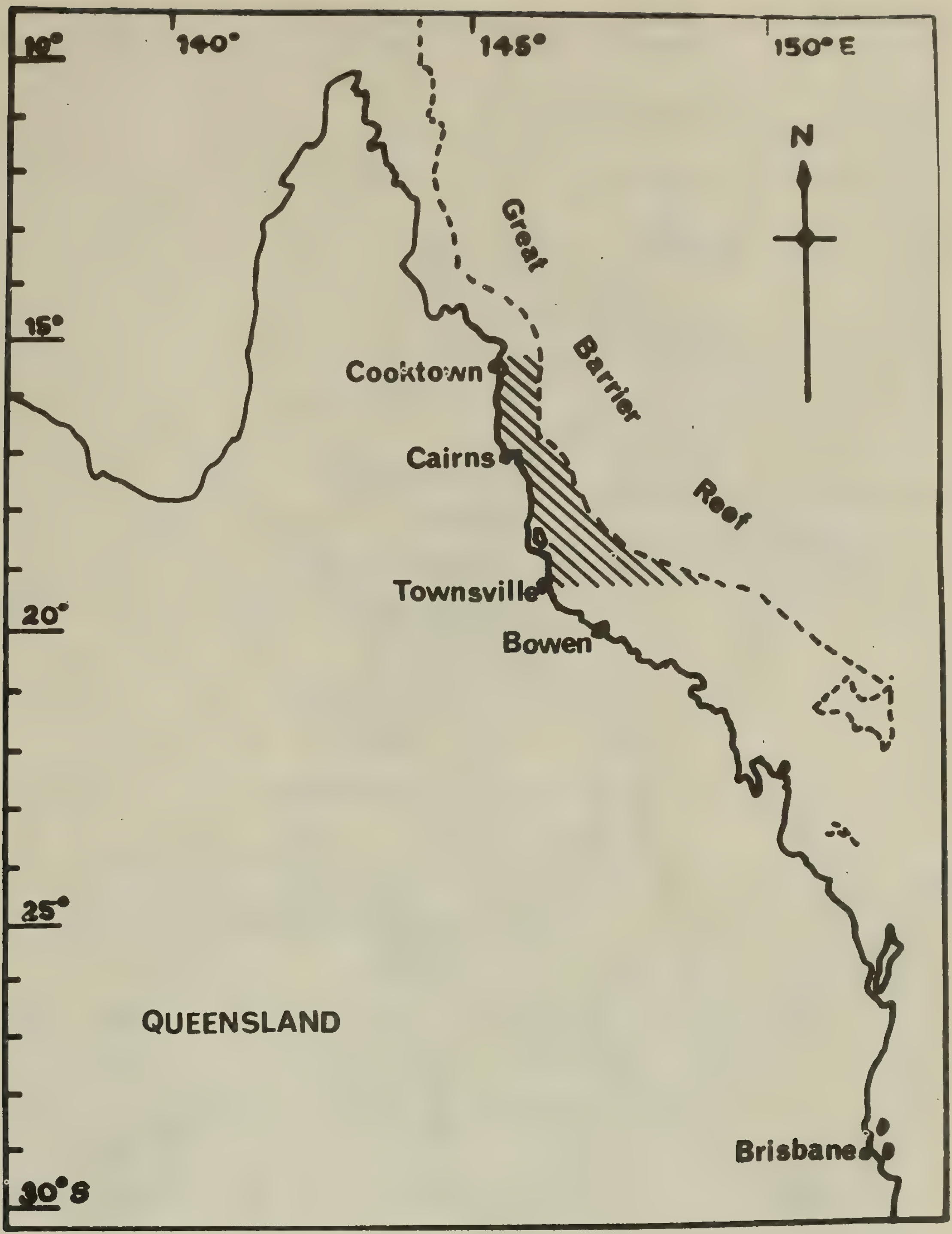
Table 3 cont'd.

Reef	Date	Habitat	Remarks
"Centipede"	25.5.70	On top of coral pinnacle in lagoon.	Adult. No *A. planci* seen in immediate vicinity.
Shell	28.10.70	On top of coral pinnacle in lee of reef.	Adult. No A. planci seen in immediate vicinity.
Tabias	21.8.70	Among coral on floor of lagoon.	Adult. A few *A. planci* seen in vicinity.

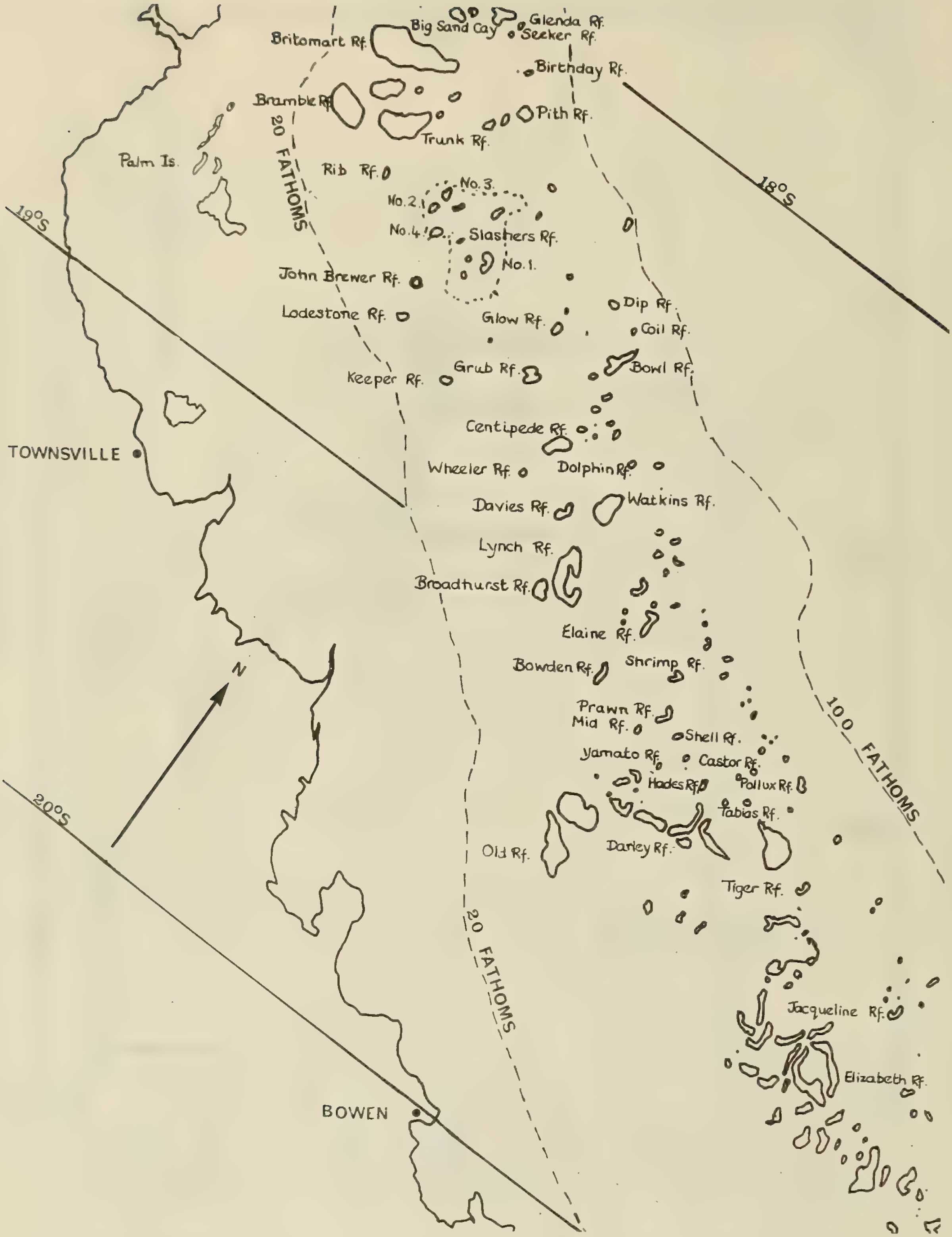
TABLE 4. SIZE FREQUENCY OF A. PLANCI POPULATION SAMPLES

Reef	Date	Number of specimens	Total diameter (cm)*		
			Mean + S. E.**	Range	S.D.***
Slashers No. 4	27.1.71	102	10.9 ± 0.2	7 - 15	1.8
Glow	28.1.71	28	9.2 ± 0.2	7 - 12	1.1
Glow	28.1.71	74	23.2 ± 0.5	17 - 36	4.7
Nathan	26.9.69	635	16.4 ± 0.3	4 - 31	7.1
Nathan	27.1.70	145	17.7 ± 0.5	8 - 32	5.6
Lodestone	29.5.70	89	31.2 ± 0.6	17 - 43	5.9
Trunk	14.12.69	296	26.7 ± 0.5	8 - 43	8.2
"Big Sand Cay"	26.5.71	44	25.7 ± 0.7	20 - 32	4.6
Slashers No. 1	17.8.70	65	39.2 ± 0.5	31 - 47	3.9
Broadhurst	1.2.70	95	37.9 ± 0.6	19 - 50	5.6
Bramble	13.12.69	145	32.0 ± 0.4	14 - 39	4.2

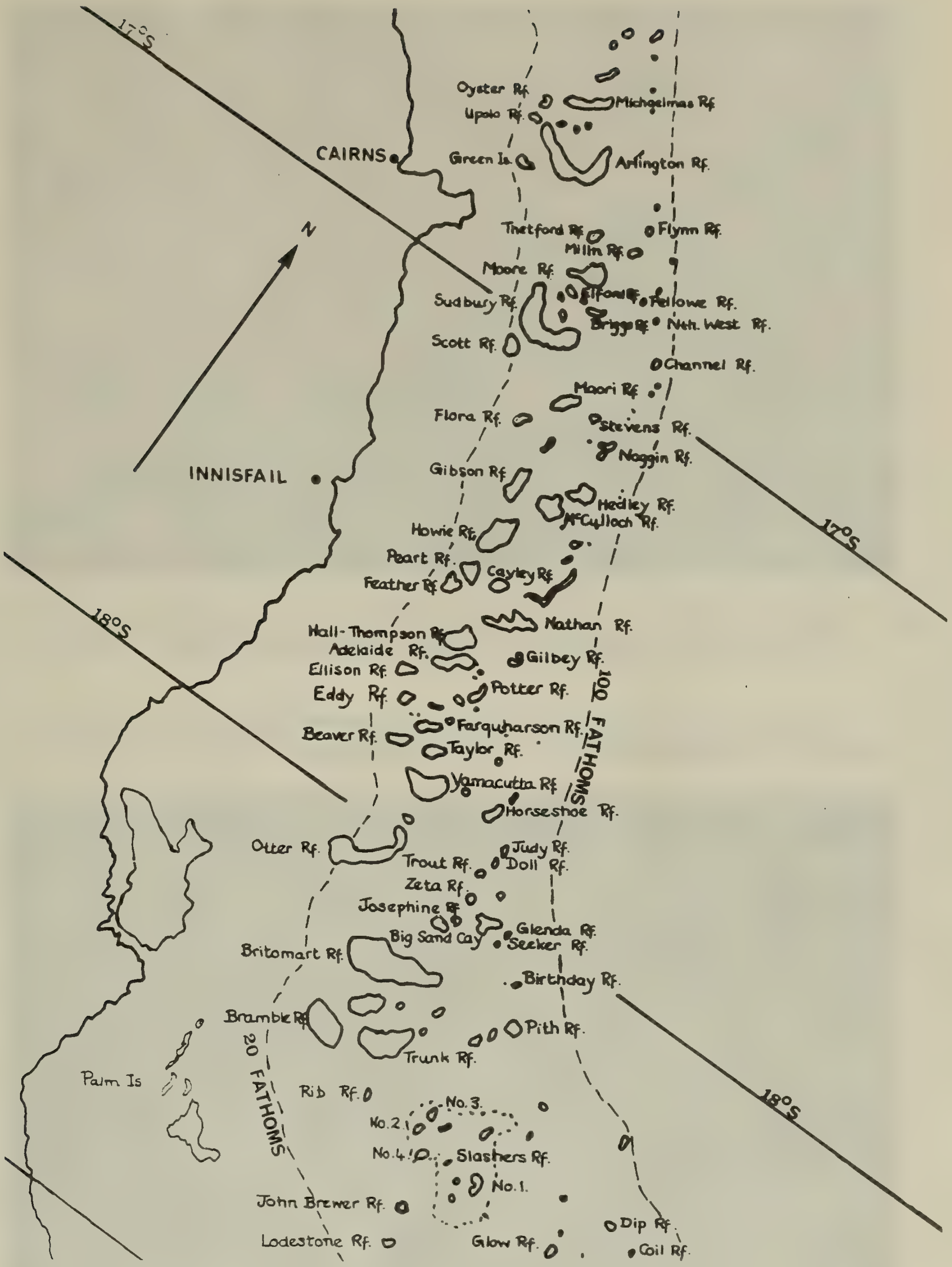
* Twice maximum radius (centre of disk to tip of longest arm)
** Standard error
*** Standard deviation



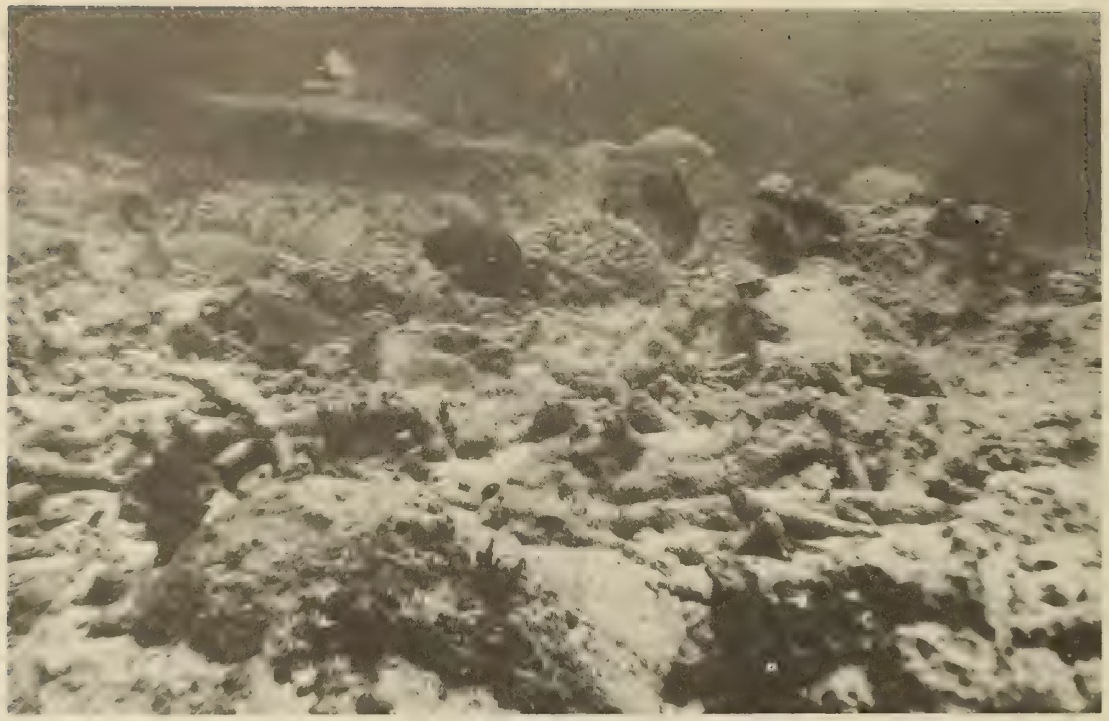
1 Map of Queensland and the Great Barrier Reef. The shaded area represents the region of the Great Barrier Reef affected by the *A. planci* plagues.



2 Map of portion of the Great Barrier Reef showing the positions of some of the reefs visited during the present investigation. The positions of 8 reefs referred to in this paper but not visited during this investigation are also shown.

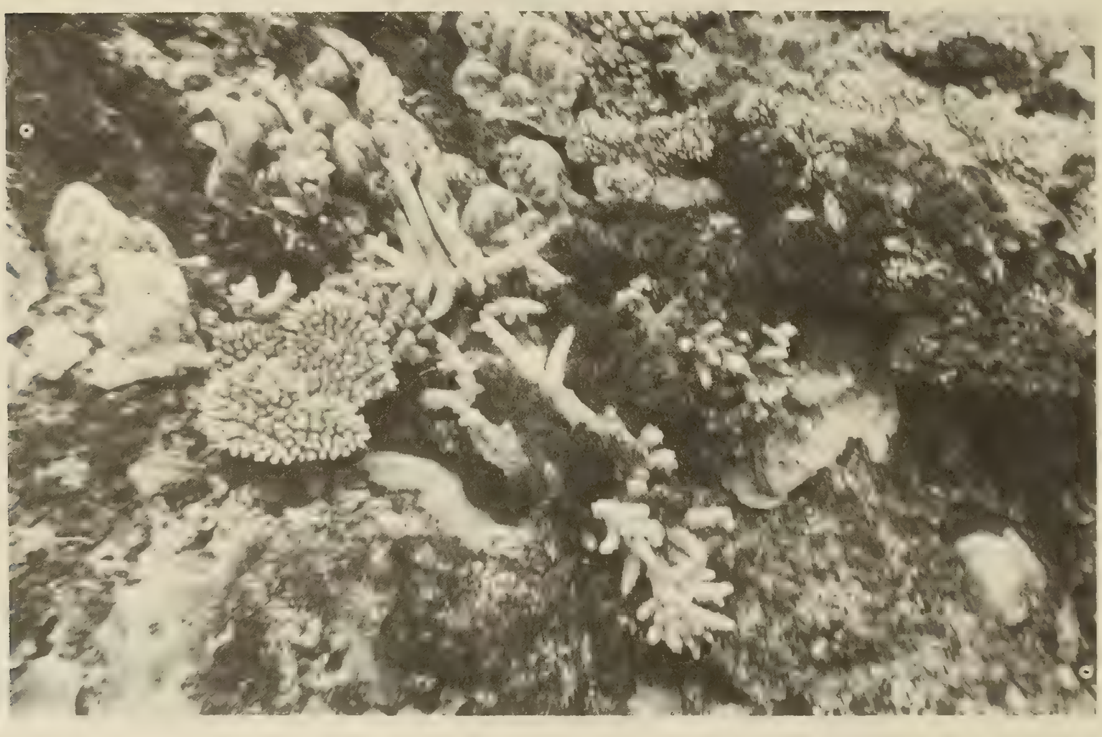


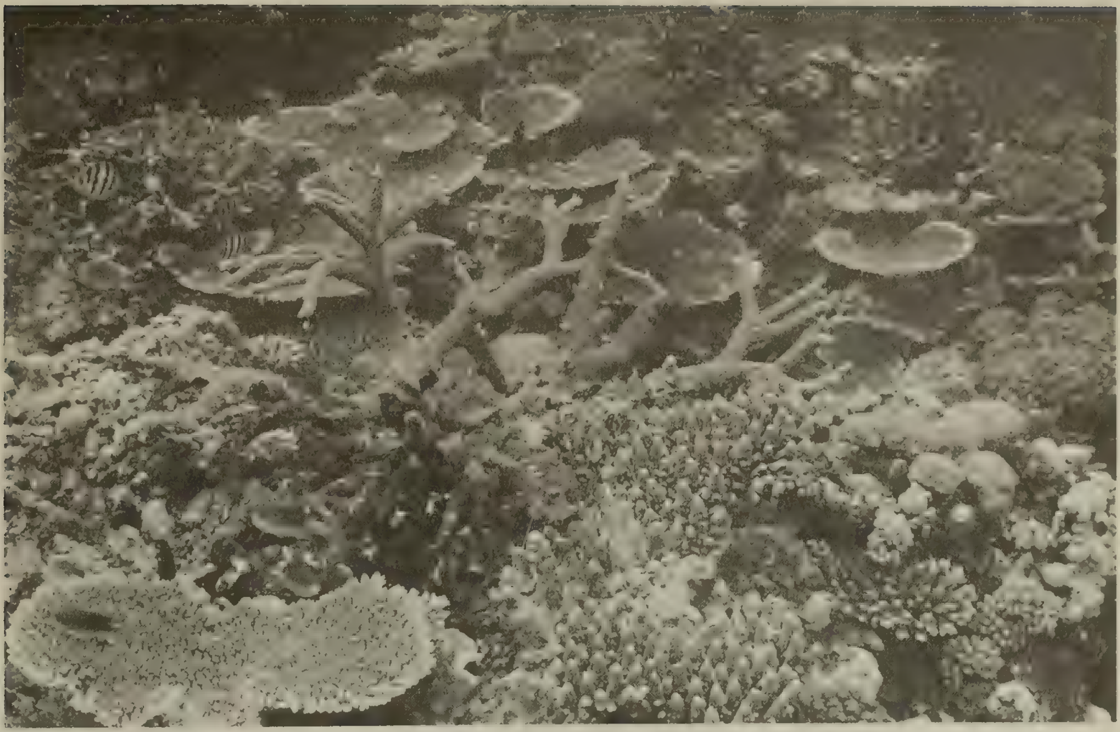
3 Map of portion of the Great Barrier Reef showing the positions of the remainder of the reefs visited during the present investigation.



4 Portion of back reef area west of sand cay at Beaver Reef illustrating sparse hard coral cover (December, 1970).

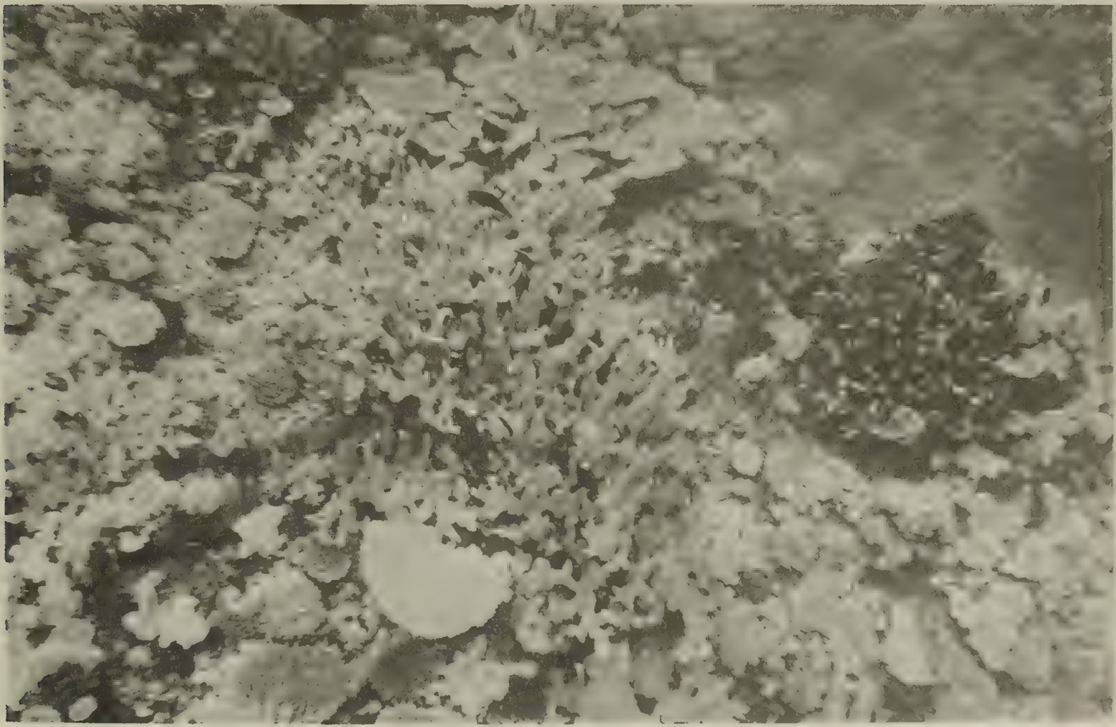
5 Portion of seaward slope on south-east side of Glow Reef illustrating moderate hard coral cover (January, 1971).

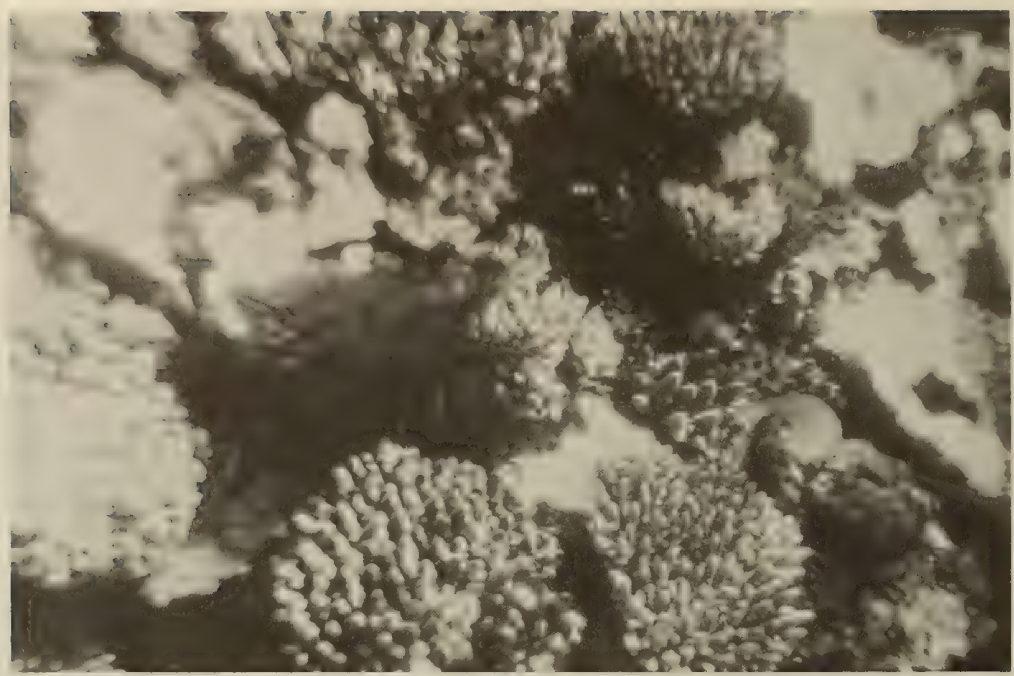




6 Portion of seaward slope on north-east side of Potter Reef illustrating dense hard coral cover (May, 1971).

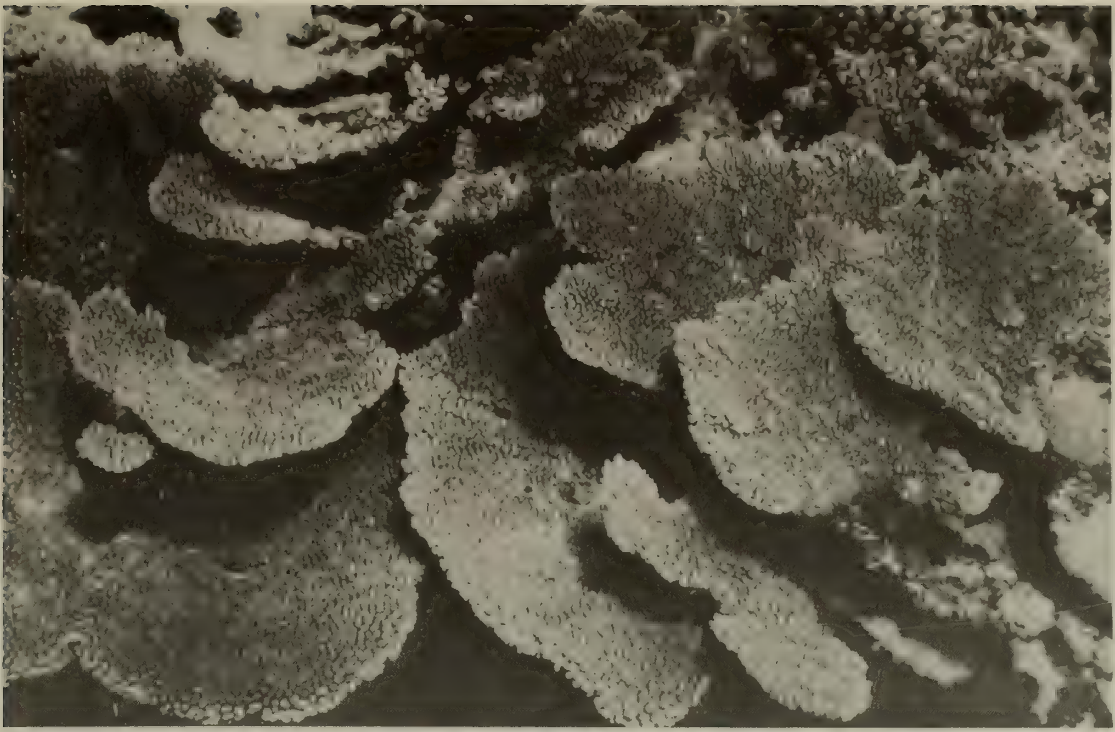
7 Portion of seaward slope on east side of Coil Reef illustrating low damage to hard corals caused by A. planci.





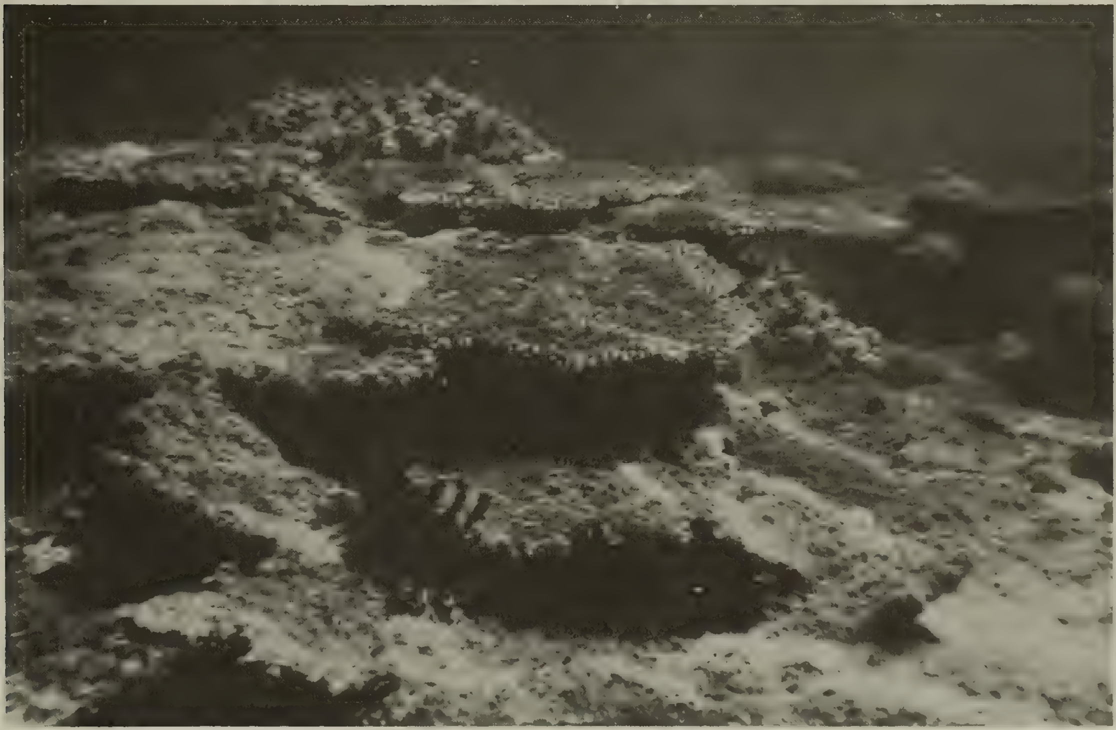
8 Portion of seaward slope on west side of Trout Reef illustrating marked damage to hard corals caused by A. planci. A specimen of A. planci is visible near the centre of the photograph (December, 1969).

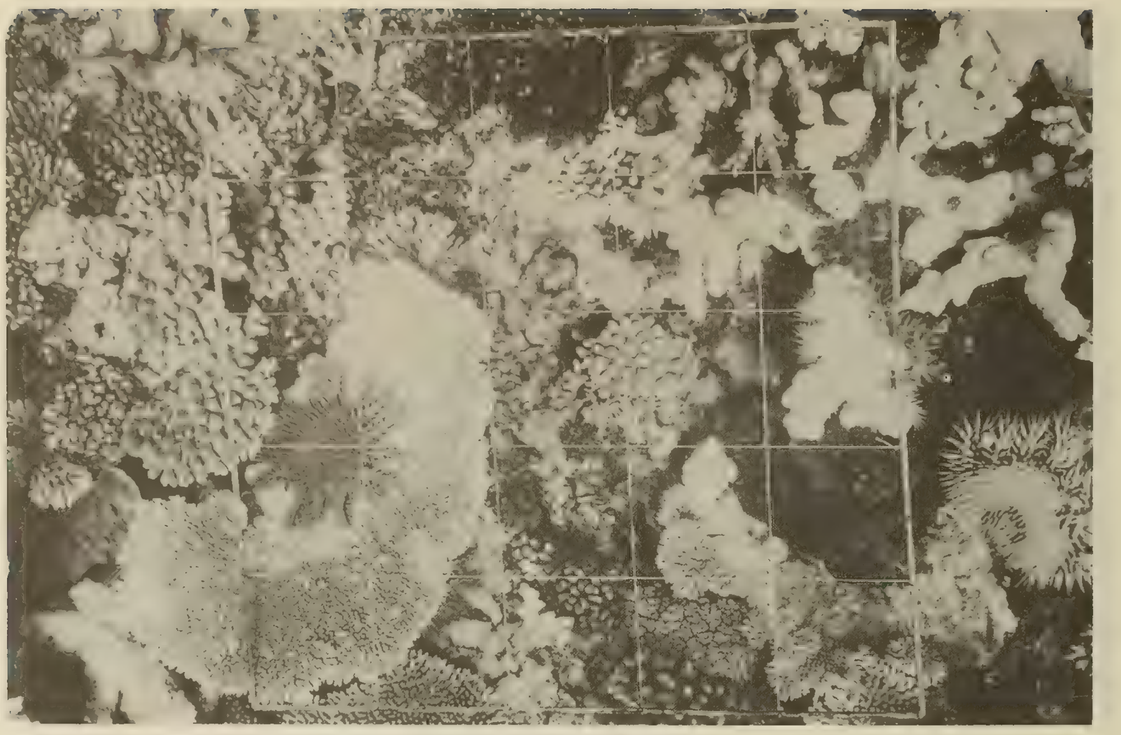
9 Portion of seaward slope on east side of John Brewer Reef illustrating heavy damage to hard corals caused by A. planci (January, 1971).



10 Living tabular acropores on reef crest on north side of Broadhurst Reef (October, 1970).

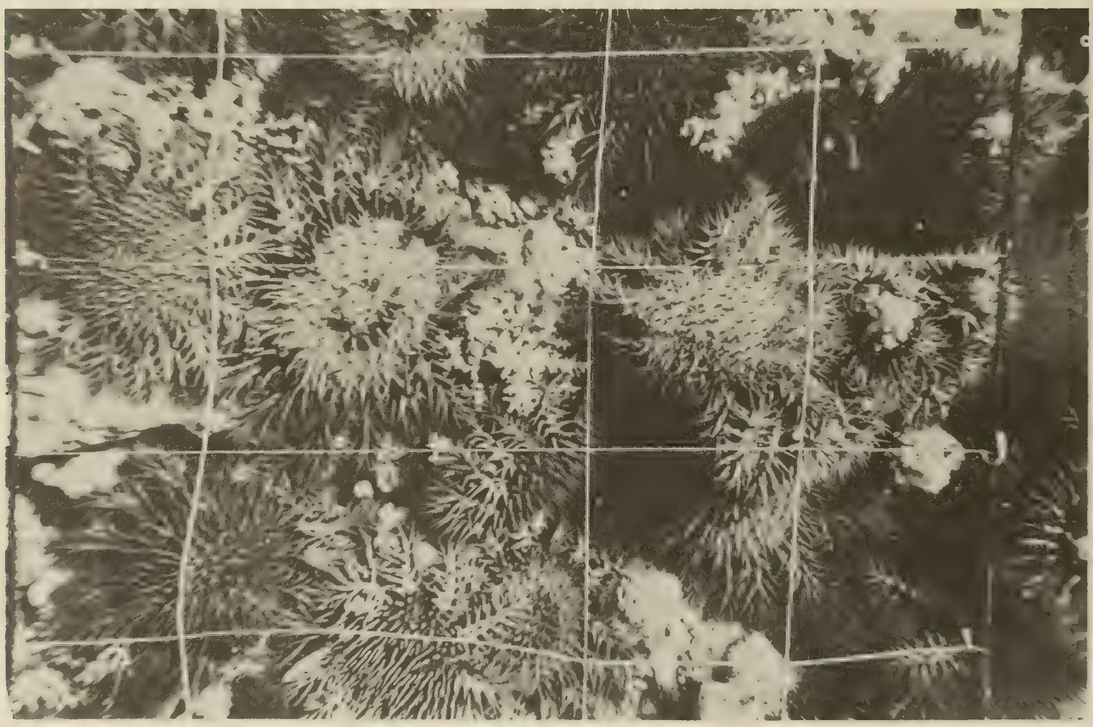
11 Skeletons of tabular acropores killed by A. planci on seaward slopes on north side of Broadhurst Reef (February, 1970).

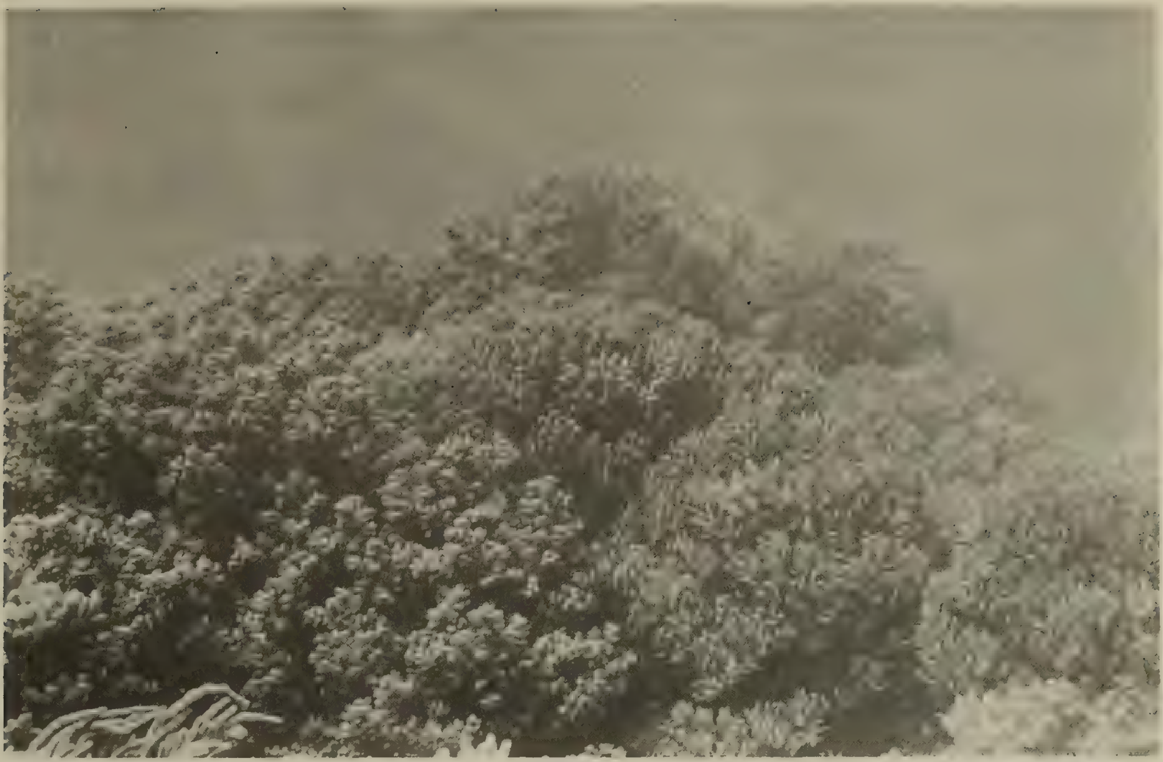




12 Photograph of quadrat in position on seaward slope at northern tip of Lodestone Reef (July, 1970). Analysis of reef cover in quadrat yields 26.3% LHC, 37.3% DHC, 0% SC and 36.4% ADS.

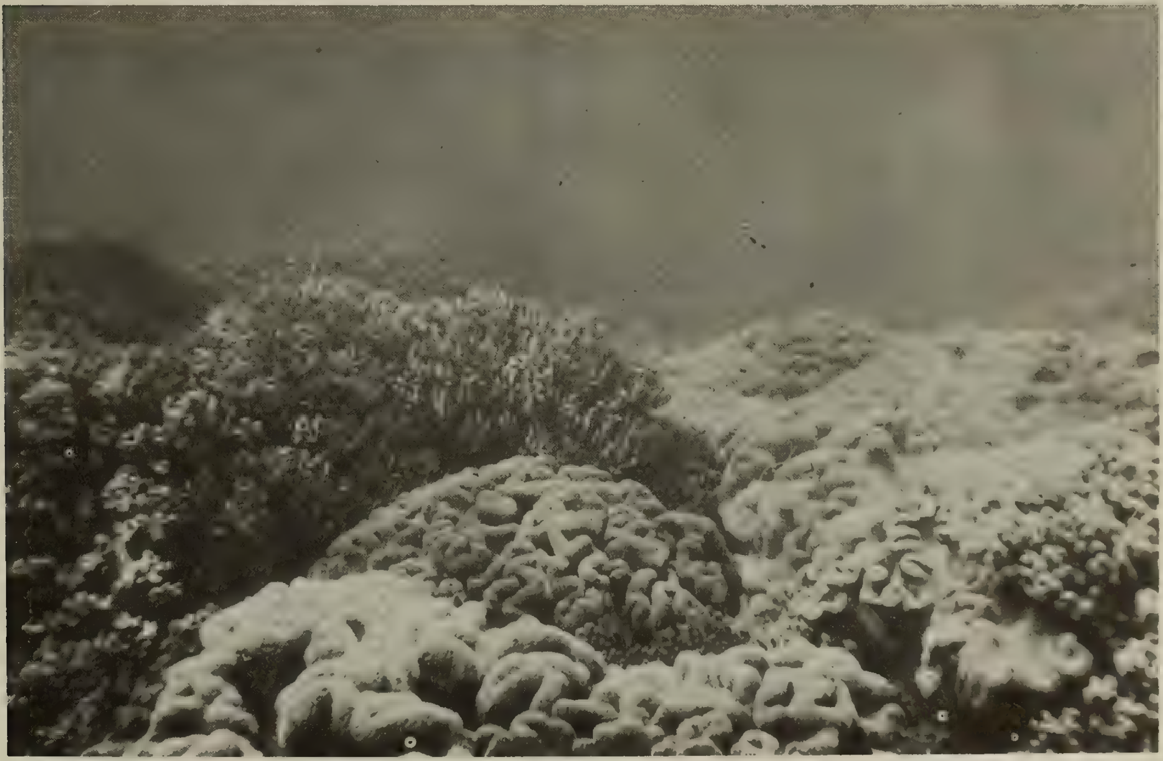
13 Massed specimens of A. planci underlying part of a quadrat on the reef flat at Slashers No.1 Reef (August, 1970).

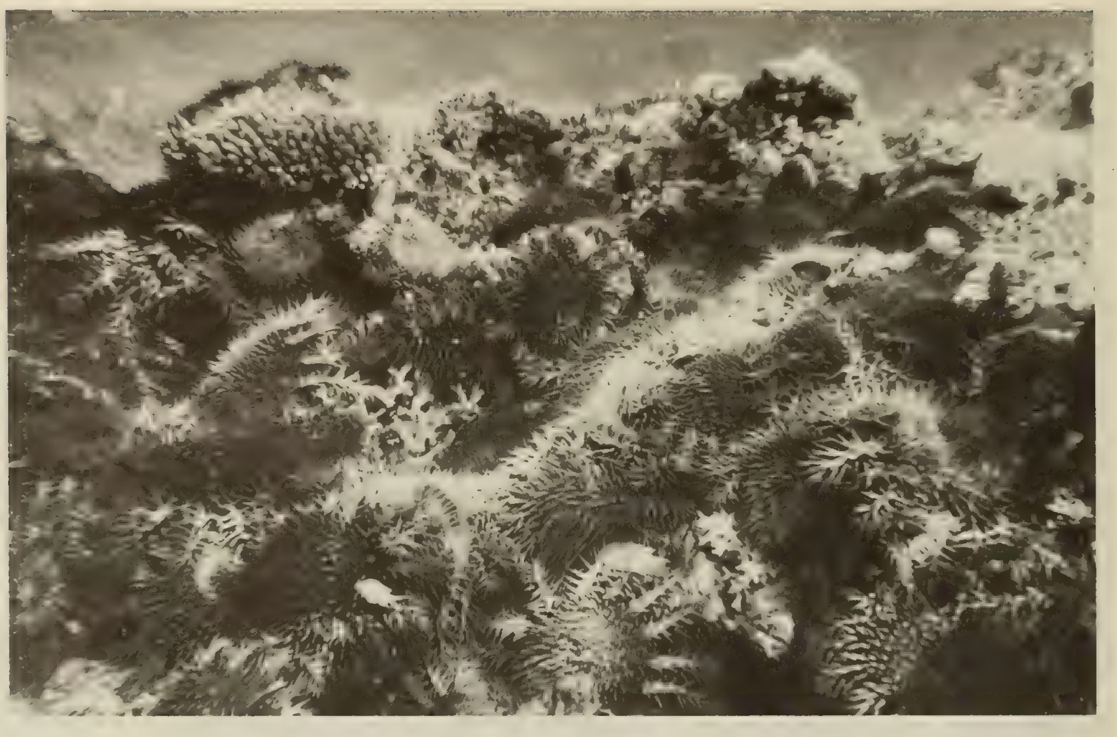




14 Soft coral cover on reef flat near sand cay at Taylor Reef (May, 1971).

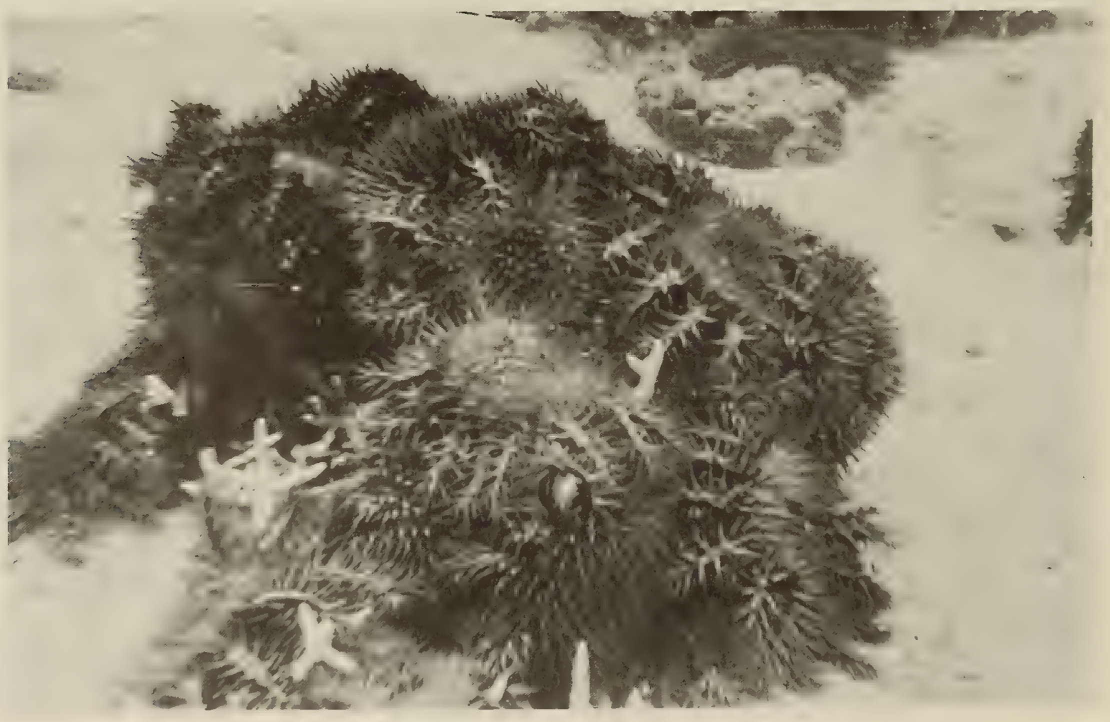
15 Soft coral cover on reef flat near sand cay at Taylor Reef (May, 1971).

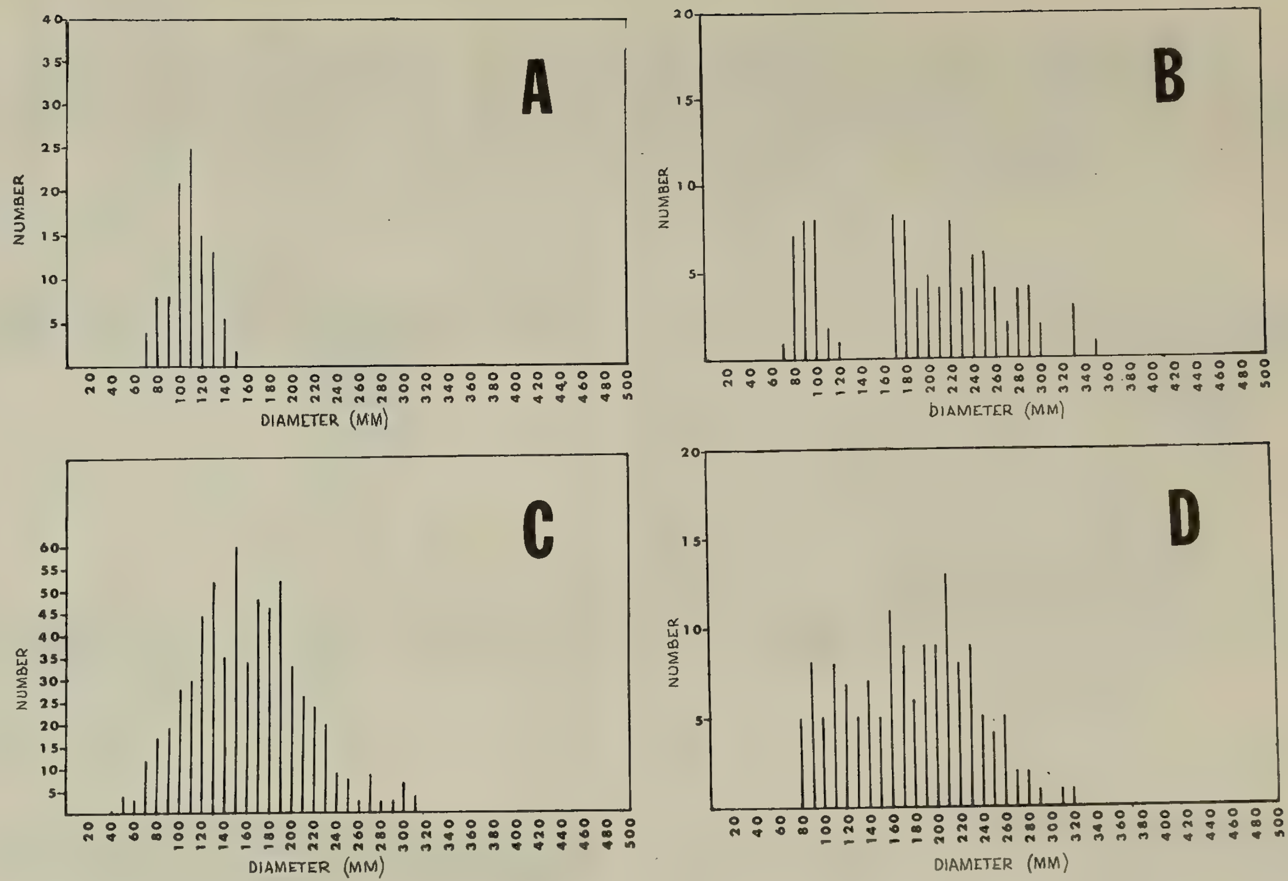




16 Large numbers of A. planci on hard corals on reef flat at Slashers No.1 Reef (August, 1970).

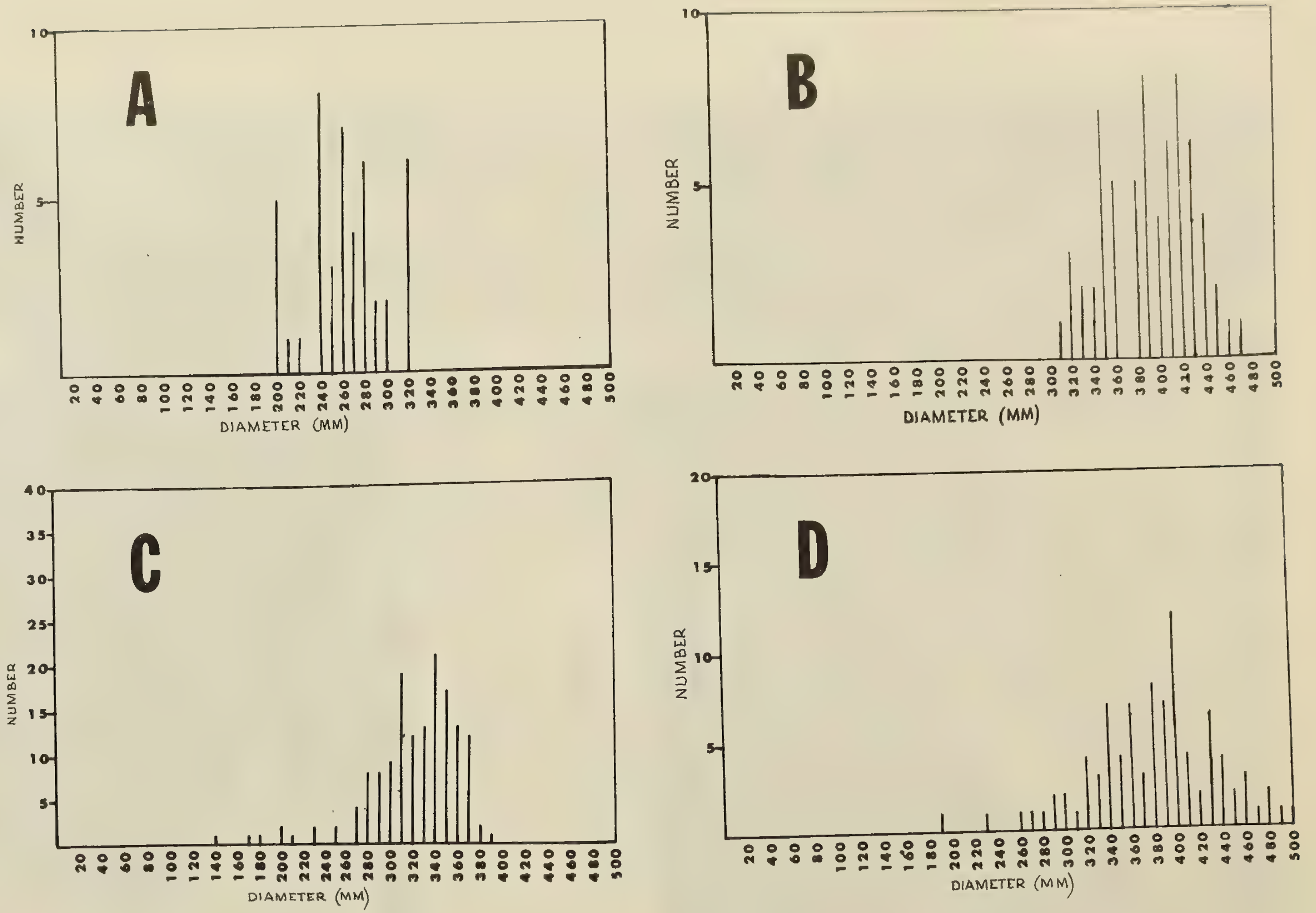
17 A colony of staghorn coral almost completely enveloped by a mass of feeding A. planci at Slashers No.1 Reef (August, 1970).





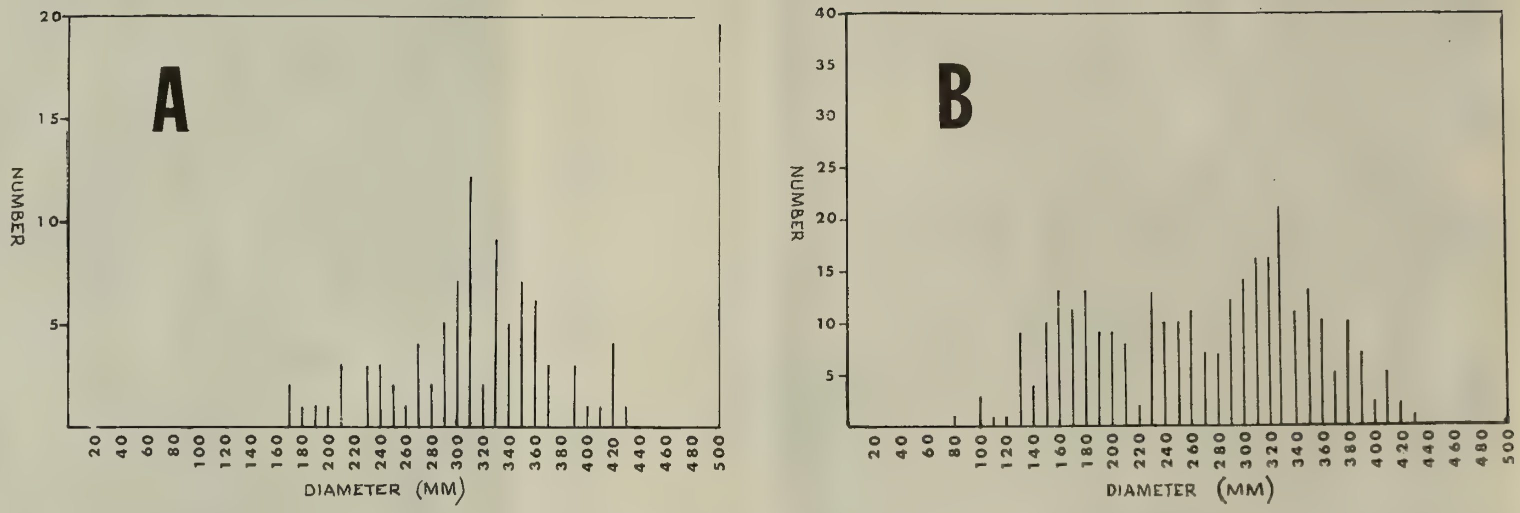
18 Graphs showing size frequencies of populations of *A. planci*.

A. Population sample from reef crest at Slashers No.4 Reef on 27.1.71.
B. Population sample from reef crest and seaward slope south east of Glow Reef on 28.1.71. Specimens in the size range 70-120 mm were collected on the reef crest, the remainder from the reef slope.
C. Population sample from a coral pinnacle in the back reef area at Nathan Reef on 26.9.69.
D. Population sample from a coral pinnacle in the back reef area at Nathan Reef on 27.1.70.



19 Graphs showing size frequencies of populations of A. planci.

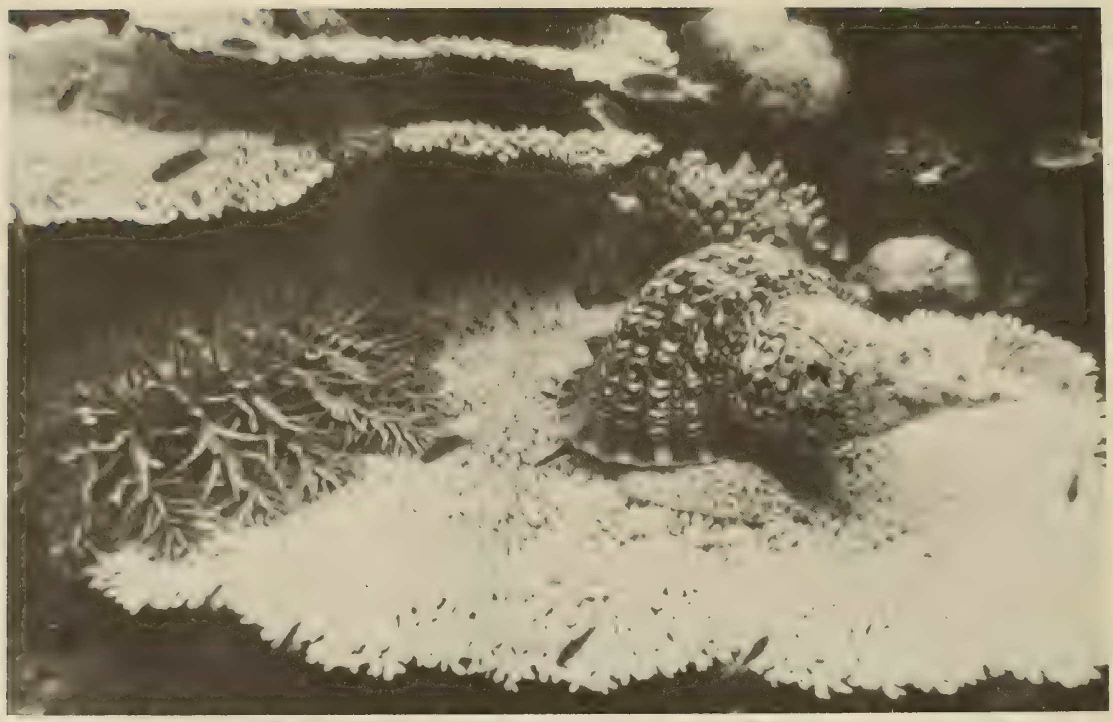
A. Population sample from back reef area at Big Sand Cay Reef on 26.5.71.
B. Population sample from the reef flat at Slashers No.1 Reef on 17.8.70.
C. Population sample from west side of lagoon at Bramble Reef on 13.12.69.
D. Population sample from seaward slope, northern tip of Broadhurst Reef on 1.2.70.



20 Graphs showing size frequencies of populations of A. planci.

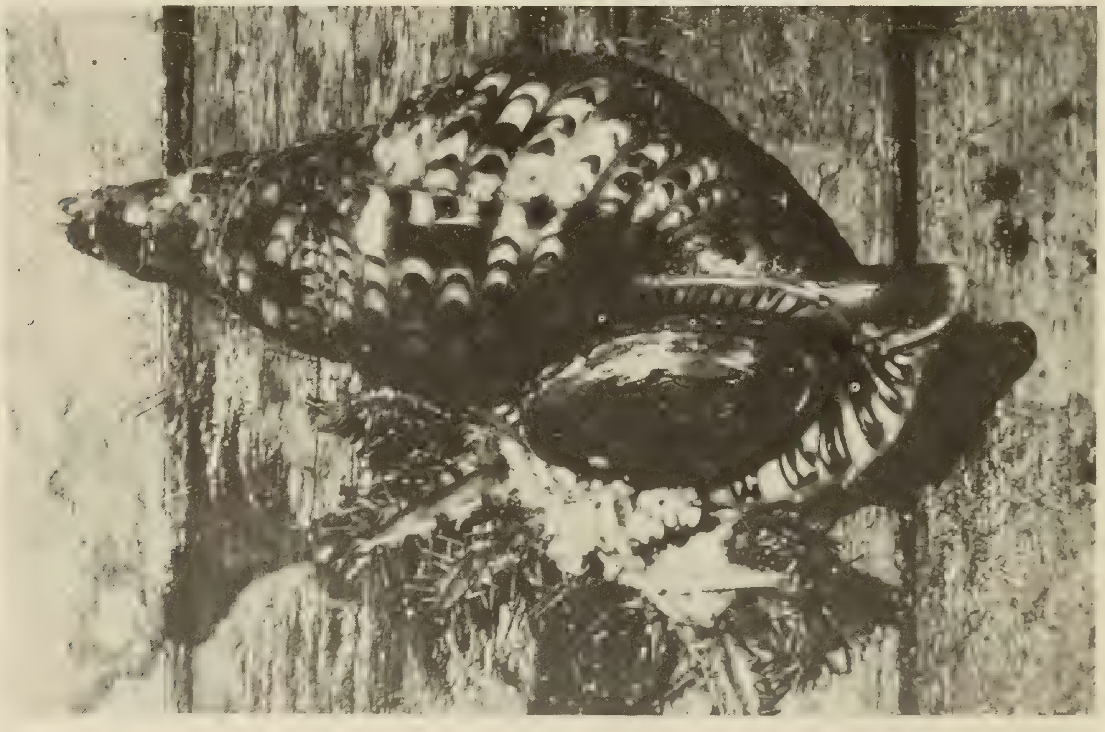
A. Population sample from seaward slope, northern tip of Lodestone Reef on 29.5.70.

B. Population sample from reef crest and seaward slope, south west corner of Trunk Reef on 14.12.69.



21 The giant triton, *Charonia tritonis*, approaching a specimen of *A. planci* which is feeding on a tabular acropore at Lodestone Re (May, 1970).

22 *Charonia tritonis* captured while eating a specimen of *A. planci* at Nathan Reef (January, 1970).



ATOLL RESEARCH BULLETIN

NO. 168

THE APPARENT EXTENT OF RECOVERY OF REEFS OF AUSTRALIA'S GREAT BARRIER REEF DEVASTATED BY THE CROWN-OF-THORNS STARFISH

by R. Endean and W. Stablum

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THE SMITHSONIAN INSTITUTION
Washington, D.C., U.S.A.

Contents

	Page
Abstract	1
Introduction	2
Materials and Methods	2
Results	4
Discussion	10
Acknowledgements	13
References	14

Figures (following p. 14)

1 Map of portion of the Great Barrier Reef lying off the east coast of Queensland, Australia. The names and positions of reefs visited during the investigation are shown.

2 The white exposed skeleton of an acropore colony which had just been killed by *Acanthaster planci* (Slashers No.1 Reef; August, 1970).

3 The white exposed skeleton of a colony of a species of *Platygyra* which has just been killed by specimens of *Acanthaster planci* visible to the left of the colony (Slashers No.4 Reef; January, 1971).

4 The skeleton of a branching acropore believed to have been killed some weeks earlier when large numbers of *A. planci* invaded this region of the reef flat at Taylor Reef. Dark filamentous algae cover much of the skeleton (January, 1970).

5 The algal covered skeleton of a massive coral believed to have been killed by *A. planci* some months previously (lagoon, Yamacutta Reef; May, 1971).

6 Portion of the reef face on the seaward slope at the eastern side of John Brewer Reef showing the algal covered skeletons of tabular acropores and other corals still *in situ* (January, 1971). Large numbers of *A. planci* were active in the area in 1970.

7 Smashed skeletons of acropore colonies on the seaward slope, eastern side of Hall-Thompson Reef (May, 1971).

8 Large numbers of fish aggregated in the vicinity of one of the few large acropore colonies which had survived the *A. planci* invasions of the reef flat at Slashers No.4 Reef (January, 1971).

9 Part of a damaged colony of a species of *Acropora*. Living tissue has been stripped from the bulk of the skeleton which is covered with dark algae. Surviving polyps are present on the tips of two branches which are free of fouling algae (reef flat, Slashers No.4 Reef; January, 1971).

10 Partially damaged colonies of staghorn acropores many of which have collapsed owing to fracture of regions of the skeleton from which living tissue had been removed some months earlier apparently by *A. planci* (north side, seaward slope, McCulloch Reef; July, 1971).

11 The white freshly exposed skeleton of part of this massive coral colony marks the passage of a feeding *A. planci* (Slashers No.4 Reef; January, 1971).

12 Two partially damaged colonies of a species of massive coral (probably *Leptoria phrygia*). Damaged portions are covered with black fouling algae (Yamacutta Reef; May, 1971).

13 Portion of a damaged colony of a species of *Favia*. Living coral polyps are visible on the left side of the colony. The living tissue had been removed from the remainder of the colony several months earlier by *A. planci* which is known to have been active in the area (seaward slope, Hall-Thompson Reef; May, 1971).

14 A damaged colony of a species of *Porites* showing colonies of alcyonarians growing on part of the exposed skeleton of the colony (south-east side, seaward slope, Green Island Reef; November, 1970).

15 Soft corals growing on the skeletons still *in situ* of hard corals believed to have been killed by *A. planci* about 1966 (northern tip, Feather Reef; July, 1971).

16 Colonies of soft corals forming a carpet over coral skeletons lying on floor of west side of lagoon at Taylor Reef (May, 1971). Starfish are known to have been active in the area in 1969.

17 A patch of a green species of *Turbinaria* partially enclosed by a quadrat frame photographed on the south-eastern side, seaward slope of Green Island Reef (November, 1970).

18 A recently settled colony of *Acropora humilis* on a "clean" reef surface (back reef area, Ellison Reef; May, 1971).

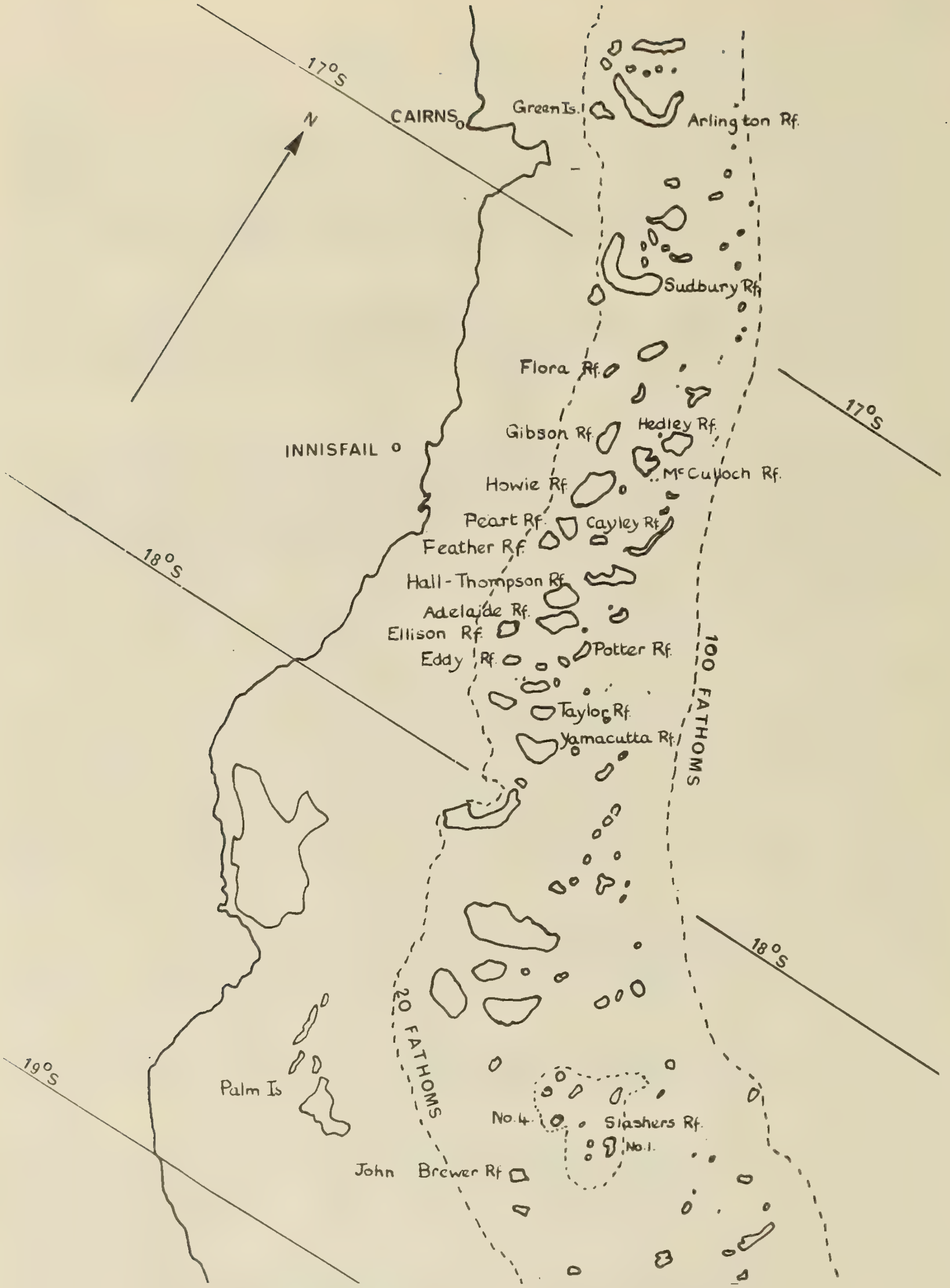
19 A colony of a species of *Acropora* estimated to have settled in 1968 or 1969 on the seaward slope, north side of McCulloch Reef. The colony is surrounded by algae (July, 1971).

20 A tabular acropore skeleton carrying a recently settled colony of *Acropora hyacinthus* is shown near the centre of the photograph. Soft corals cover other hard coral skeletons in the foreground. Starfish were active in the area in 1966 (northern tip, seaward slope, Feather Reef; November, 1970).

21 Portion of a branch of an acropore colony being attacked by a specimen of _A. planci_. The basal portion of the branch (to the left) was algal covered and was considered to have been stripped of living coral tissue by starfish some months earlier (reef flat, Slashers No.4 Reef; January, 1971).

22 A specimen of _A. planci_ attacking part of the edge of a tabular acropore which had survived earlier devastation of the rest of the colony and had continued to grow (Taylor Reef; January, 1970).

23 The white, freshly exposed skeleton of portion of a colony of a species of _Platygyra_ which had survived the earlier destruction of the remainder of the colony. The remainder of the colony is covered with dark algae and is estimated to have been killed some weeks earlier probably by _A. planci_ (reef flat, Slashers No.4 Reef; January, 1971).



1 Map of portion of the Great Barrier Reef lying off the east coast of Queensland, Australia. The names and positions of reefs visited during the investigation are shown.

THE APPARENT EXTENT OF RECOVERY OF REEFS OF AUSTRALIA'S GREAT BARRIER REEF DEVASTATED BY THE CROWN-OF-THORNS STARFISH

by R. Endean and W. Stablum[1]

ABSTRACT

Visits were made to 21 reefs of the Great Barrier Reef lying between Lat. 16° 30' S. and 19° S. A massive destruction of the hard coral cover of most of these reefs had occurred during the 1960's as a result of the feeding activities of very large numbers of the coral predator *Acanthaster planci*. The extent, rate and manner of recovery of these reefs were studied.

Coral colonies growing in shallow water exposed to heavy wave action had survived the starfish invasions but elsewhere the amount of surviving hard coral was remarkably small. Colonies of *Millepora* had survived and these and surviving colonies of *Pocillopora* and *Turbinaria* had spread over surrounding areas and occurred in patches on some reefs. The skeletons of corals killed by *A. planci* remained *in situ* but rapidly acquired a coating of fouling algae. Portions of some coral colonies survived and continued to grow but the living coral tissue did not appear to spread over damaged parts of the colonies, the exposed skeletons of which acquired a coating of algae and other organisms. Subsequently exposed acropore skeletons frequently fragmented. Fragmented skeletons and skeletons still *in situ* were frequently covered by soft corals which spread rapidly over large areas of the devastated reefs.

Although 4 - 8 years had elapsed since *A. planci* was active in many of the reef areas studied, recolonization by hard corals was generally slight and species diversity among the recolonizers was low. The extent of recolonization by hard corals in the reef sectors studied appeared to be inversely related to the extent of coral destruction caused by the starfish. Many of the recolonizing corals had settled on acropore skeletons which will ultimately crumble and the recolonizers will be lost. It is apparent that recovery of devastated reefs will be a prolonged process and the presence of residual starfish populations on some reefs raises the possibility that many reefs may remain impoverished indefinitely.

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INTRODUCTION

It has gradually become apparent that a massive destruction of the hard coral cover of reefs of the central region of the Great Barrier Reef lying between approximately Lat. 15° S. and 19° S. has occurred during the 1960's because of the feeding activities of very large numbers of the coral predator Acanthaster planci (Barnes and Endean, 1964; Barnes, 1966; Endean, 1969; Pearson and Endean, 1969; Talbot and Talbot, 1970; Endean and Stablum, 1973). Interest is now focused on the rate at which devastated reefs in the region will recover from the starfish invasions, on the manner in which recovery will proceed and on the ultimate extent of this recovery.

It was known that by mid 1969 the bulk of invading starfish had departed from most of the inner platform reefs lying between Lat. 16° 30' S. and 18° S. and in 1970 it was decided to visit some of these reefs and examine their surface cover. Particular attention was to be given to assessments of the extent, rate and manner of recovery of the hard coral cover of affected reefs and to factors which could hamper or assist that recovery. In order to provide data to assist in these assessments visits were also made to areas of two outer patch reefs which had escaped starfish infestation, to areas of reefs where large numbers of starfish were killing coral and to areas of reefs from which large numbers of starfish had just departed.

MATERIALS AND METHODS

The reefs visited in this survey are shown in Fig. 1. Most are regarded as inner patch reefs but two (Hedley Reef and Potter Reef) are near the 100 fathom line and are regarded as outer patch reefs. General surveys of sectors of these reefs were made as described in the preceding Bulletin. Visual estimates (Table 1) were made of the extent and general condition of the living hard coral cover and of the extent of recent settlement of hard coral colonies in the reef sectors examined. Information on the positions, depth and estimated areas of reef sectors examined is given in Table 1. Special attention was given to surveys at Green Island Reef and Feather Reef since preliminary studies of recolonization at localities on these reefs have been carried out by Pearson and Endean (1969). Also, information on the approximate dates when the various sectors of the reef at Green Island were invaded by starfish is available (Barnes, 1966). The six areas examined during the present survey of Green Island correspond with the sectors designated A, B, C, D, E & K by Barnes (1966). Four areas were examined at Feather Reef. The first was sitauted on the seaward slopes at the northern tip of the reef. The second, third and fourth areas were situated to the south on the seaward slopes along the eastern edge of the reef. The four areas were separated one from another by distances of approximately 800 metres.

The principal criterion used to determine whether a coral colony was recently established was its very small size relative to the mean size attained by the species in the Great Barrier Reef region. In many cases the small corals were attached to the skeletons of recently killed corals which were still in situ. When such small colonies belonged to species different from the species to whose skeleton they were attached they could definitely be regarded as recolonizers. In those cases where the small colony belonged to the same species as the exposed skeleton with which it was associated it was possible that the small colony had regenerated from surviving portions of a damaged coral colony. However, in most cases no difficulty was encountered in distinguishing recolonizing corals from surviving corals. The extent of the soft coral (alcyonarian) cover in each area investigated was also estimated.

Attempts were made to ascertain the dates when the reef areas listed in Table 1 carried large numbers of starfish. Unfortunately, the exact dates are not available. However, information is available on the years when the various regions of Green Island Reef became infested with starfish (Barnes, 1966). Information is also available on the year when the area examined at Slashers No.1 Reef was infested and the years when John Brewer Reef was infested by starfish (Endean and Stablum, 1973). Many of the other reefs listed were visited in 1966 and were found to be infested with starfish (Pearson and Endean, 1969). Information obtained from operators of charter boats, shell collectors, divers, and from fishermen has assisted in establishing the approximate dates when some reefs carried large numbers of starfish.

At some localities sampling stations were set up and attempts were made using a sampling technique described in a previous paper (Endean and Stablum, 1973) to obtain information on the extent of the living hard coral cover, on the percentage of recently established coral colonies in this cover and on the percentage of the reef surface covered by soft corals. To obtain this information a transect line was run out at the reef sector to be examined. Usually the reef sector examined embraced part of the seaward slopes on the windward side of the reef where coral growths are well developed. However, a back reef area was sampled at Ellison Reef, the transect at Yamacutta Reef was across the shallow water of reef crest and reef flat and the transect at Slashers No.1 Reef was made on the reef flat while large numbers of starfish were eating the coral there. A metre square quadrat was placed at intervals along the transect line and photographed. Two identical prints were made of each negative obtained. One was kept as a record. From the duplicate the images of recently settled hard corals, other living hard coral colonies and soft coral colonies respectively were carefully excised. The remaining reef cover was regarded as algal dominated substratum. The pieces belonging to each category were weighed to the nearest 0.0001 gram and each weight thereby obtained was expressed as a percentage of the total weight of the print. This procedure yielded the percentage area of each print occupied by each category of reef cover investigated and it was assumed that the figure obtained in each case approximated the actual percentage area occupied by the particular category of reef cover in the area of reef surface shown in the print. The area depicted in each print approximated 1 metre squared (mean for 191 prints was 1.07 and the range was 0.88-1.52). Mean figures for the percentage area occupied by each category of reef cover on each transect were then calculated and are listed in Table 2. The number of quadrat photographs included in the analysis of each transect and the mean number of recolonizing hard corals per photograph are also shown in Table 2.

The diameters of the skeletons of recently killed coral colonies were measured at some localities. Also, a collection of recolonizing corals was made at some localities for subsequent identification. Although the commonest of the recolonizing corals were included in the collections no attempt was made to ensure that all species represented among the recolonizers were collected. Algae associated with dead coral skeletons were collected at Slashers No.1 Reef for subsequent identification.

Cursory observations were made on the fish fauna of some damaged reefs visited with a view to ascertaining whether the species composition and abundance appeared markedly different from those of the fish fauna of reefs which had not been damaged by A. planci.

RESULTS

When feeding, A. planci digests the flesh of its coral prey. The skeleton of the prey is thereby exposed. In August, 1970 a study was made of the genera of hard coral colonies attacked by A. planci on an area of the reef flat at Slashers No.1 Reef. Almost every colony of Acropora, Pocillopora and Stylophora present was attacked. Likewise very few massive corals escaped attention from A. planci. Information relating to the genera and sizes of massive coral colonies killed by the starfish is given in Table 3. It was noted that every polyp in a coral colony attacked by one or more starfish is usually killed. Only occasionally, particularly when tall branching acropores were attacked, did small portions of a colony survive.

On some reefs, colonies of Pocillopora were frequently but by no means always bypassed. Although very large massive corals (particularly colonies of species of Porites and Astreopora) were bypassed on some reefs (e.g. John Brewer Reef, Cayley Reef), on other reefs (e.g. Hall-Thompson, Slashers No.1 Reef), large colonies of Porites and Astreopora, some exceeding 2 metres in diameter, were attacked and killed. The impression gained was that A. planci exhibited a preference for tabular Acropora species and small colonies of massive corals but when aggregated in very large numbers (tens of thousands) on a reef would attack almost every colony of coral on the reef. Among the colonies which usually escaped attack were those growing on reef crests and in shallow water on the tops of coral pinnacles exposed to considerable wave action. Occasionally, coral colonies growing in deeper water, particularly at the south-eastern regions of reefs which are frequently exposed to heavy wave surge, survived the starfish invasions. Stands of the hydrozoans Millepora and Heliopora were bypassed and only rarely (e.g. at Taylor Reef) were soft corals attacked.

After attack by A. planci the skeletons of corals are exposed (Figs. 2 and 3). These remain stark white and free of adhering material for a few days but within 2-3 weeks the skeletons acquire a coating of filamentous algae. The principal alga involved at this stage is Enteromorpha clathrata (Roth) Grev. Subsequently the algal covering thickens and darkens and the coral skeletons become covered with dark tufts of algae. From a distance of a few metres large areas of the coral skeletons appear very dark, almost black, at this stage (Fig. 4). In August, 1970 such algal covered skeletons of Acropora spp. were collected from a trail of dead corals left by a large group of A. planci which were actively feeding on the reef flat at Slashers No.1 Reef. The following algal species were present: Microcoleus lyngbyaceus (Kuetzing) Crouan, Ceramium gracillimum var. byssoideum (Harv.) Mazoyer, Griffithsia tenuis C. Ag., an unidentified species of Polysiphonia and an unidentified species of Bryopsis.

The dead coral skeletons may remain covered with filamentous algae for several months or even years but frequently other types of algae, including coralline algae, gradually replace or become intermingled with the filamentous algae conferring on the dead skeletons a greyish rather than a blackish appearance (Fig. 5). The algal-covered coral skeletons often remain in situ for long periods of time (Fig. 6). Pearson and Endean (1969) refer, for example, to the skeletons of two tabular acropores (Acropora hyacinthus) which had remained in situ on Green Island for almost three years when last observed. Other skeletons are eroded by boring and abrading organisms. It was noted that after exposure for a few months the skeletons of some acropores became very friable. Presumably they had been weakened in some way but the cause was not determined. Sometimes, as was observed at Adelaide Reef, many of the flat "plates" of Acropora hyacinthus (and other tabular corals) had broken away from their points of attachment and they lay in stacks on ledges at the foot of steep reef faces. Often, as happened at Taylor Reef, Green Island Reef and Hall-Thompson Reef, the exposed skeletons of branching acropores growing in shallow water were smashed by wave action and formed piles of rubble (Fig. 7). When visited during 1970 the water over many of the reefs where damage had been particularly heavy (e.g. Sudbury, Arlington, Green and Howie Reefs) was markedly turbid compared with the situation on other reefs in the area (e.g. Thetford Reef) which had not been invaded by large numbers of A. planci.

It was noted that coral haunting fish, such as chaetodons (Chaetodontidae), pullers and humbugs (Chromidae), and damselfish (Pomacentridae), remained in the vicinity of skeletons of dead corals until these acquired a coating of algae. They were certainly absent from the algal covered hard coral skeletons but their fate was not determined. However, coral colonies which had been bypassed by A. planci seemed to have more than the usual quota of fishes (Fig. 8). Fishes were well represented on reefs which had been devastated during the early or mid 1960's but marked changes in the species composition of the fish fauna appeared to have occurred. In particular, coral trout and cod (Serranidae) appeared to be very scarce on devastated reefs while parrot fish (Scaridae), surgeon fish (Acanthuridae), and wrasses (Labridae) occurred commonly.

Occasionally, some of the tips of the branches or segments of the branches of staghorn acropores or edges of the "plates" of tabular acropores were not killed by the starfish. These undamaged areas continued to grow. Their surfaces remained free of fouling algae in contrast with the adjoining portions of the skeletons which, after initial exposure, had become covered with fouling algae (Fig. 9). These algal covered regions of the skeleton did not seem to acquire a new covering of polyps as a result of regeneration from surviving portions of the original colony. Indeed, other species of coral sometimes settled on the algal-covered parts of the skeletons. The continued growth of only portions of the original colonies of damaged acropores resulted in many assuming bizarre growth forms. Some of these regenerating colonies will be lost because the damaged portions become eroded and crumble. This was observed to have happened at some localities (Fig. 10). Occasionally too, destruction of colonies of massive corals was incomplete. In those cases where large massive corals were involved the passage of a feeding starfish across the surface of a coral colony was marked by a trail of exposed skeleton (Fig. 11). This exposed region soon acquired a coating of algae and other fouling organisms (Fig. 12). Massive corals damaged in this way were observed on areas of many reefs (e.g. Green Island Reef) from which invading A. planci had departed some years previously. It is not known whether colonies of any or all species of massive corals so damaged will in due course regenerate a covering of polyps in the damaged regions of the colonies. Budding of new polyps from the edges of the living coral tissue (Fig. 13) of such damaged colonies was not marked and if regeneration occurs it must be a slow process. Also, apart from algae, soft corals (Fig. 14) and occasionally other species of hard corals were observed to grow on the dead areas of the colonies. These organisms must compete for space with polyps from the original colony. Also, it might be expected that portions of the skeleton lacking a protective cover of polyps would be exposed to the attacks of boring organisms and invasion by micro-organisms. The presence of partially killed colonies of branching and massive corals confers a characteristic facies on a reef devastated by A. planci and it would be possible for the trained observer to deduce the cause of the devastation even after the lapse of some years.

Within a few months after reefs were devastated by A. planci an obvious increase in the soft coral cover usually occurred. The rapidly growing soft coral colonies spread over dead coral skeletons (Fig. 15) and grew around surviving coral colonies. In some areas of the reefs devastated by A. planci, the reef surface became virtually carpeted with soft corals (Fig. 16). In other areas (e.g. areas at Green Island Reef) stalked algae such as a species of the alga Turbinaria formed a cover on the skeletons of recently killed corals.

Information on the surface cover of the areas of reefs visited is given in Table 1 and Table 2. It is apparent that in 1970 and 1971 the living hard coral cover in areas visited of those reefs which had been invaded in recent years by A. planci was remarkably low when compared with the hard coral cover of areas of reefs (e.g. seaward slopes of Hedley Reef and Potter Reef) which had not been invaded by large numbers of A. planci in recent years. On the other hand, it was apparent that algae and soft corals had proliferated on reefs devastated by A. planci.

In the main, surviving coral colonies were confined to very shallow water in situations exposed to wave action (e.g. the region studied at Yamacutta Reef described in Table 2) but some species growing in deeper water such as Millepora spp. appeared to have been avoided by the starfish and had survived. Pocillopora damicornis was frequently bypassed and it too had survived in patches in deeper water. Species of Millepora and Pocillopora appear to have rapid growth rates and large patches of these corals were found on many reefs from which the bulk of starfish had departed some years ago. An unidentified green Turbinaria was also prominent in deeper water on such reefs and, in some cases at least, colonies of this species had survived the starfish invasions and had spread rapidly over surrounding areas. The presence of patches of Millepora, Pocillopora and Turbinaria should be taken into account when interpreting the data presented in Table 2. Cccasionally during transect work the quadrat fell on an area covered by colonies belonging to one of these species and the mean figure for the live hard coral cover on the transect involved rose markedly as a result. Thus the figure of 15.6% live hard coral recorded in Table 2 for one transect at Green Island stems from the fact that one quadrat sample of the 11 included in the transect included a large patch of *Millepora*. Likewise, the figure of 18.3% (Table 2) for the live hard coral cover of another transect at Green Island (Fig. 17) and the figure of 10.3% for the live hard coral cover of a transect made at Adelaide Reef (Table 2) stem from the fact that one quadrat sample at each locality included a large patch of green *Turbinaria*. The figure of 18.3% obtained for the mean coral cover of an area at the southern tip of Green Island Reef is one of the highest obtained for a reef area known to have been devastated by *A. planci*. If the figure obtained for the hard coral cover of the quadrat sample depicted in Fig. 17 were omitted from calculations and the mean hard coral cover calculated from figures obtained from analysis of the remaining 9 quadrat samples the mean hard coral cover for the transect would be 10.1%. This illustrates the need for caution when interpreting the data presented in Table 2.

Recolonization of devastated areas by hard corals was not detected at the areas visited of Sudbury, McCulloch, Howie, Flora, Eddy, Taylor, Beaver, Yamacutta, Slashers No.1, Slashers No.4 and John Brewer Reefs and it was negligible at Arlington Reef and some of the areas at Green Island Reef visited. Some recolonization was detected at other areas of Green Island Reef, and at the areas of other reefs visited (Gibson Reef, Feather Reef, Cayley Reef, Hall-Thompson Reef, Adelaide Reef and Ellison Reef), but recolonization was marked only at the region of Gibson Reef visited. All this is reflected in the figures for the number of hard coral colonies per print (equivalent to approx. one m^2 of reef surface) given in Table 2. Only the figure for the area of Gibson Reef examined is similar to those for reef areas which have escaped starfish damage (the areas of Hedley, Potter and Yamacutta Reef listed in Table 2).

Among the commonest of the recolonizers were *Pocillopora damicornis*, *Seriatopora hystrix*, *Stylophora pistillata*, *Acropora hyacinthus*, *A. humilis*, *A. variabilis*, *A. formosa*, *A. cuneata* and *A. echinata*, species of *Porites* and an unidentified green species of *Turbinaria* mentioned above.

Some (Fig. 18) of the recolonizers were found on sections of "clean" reef face devoid of the skeletons of corals killed by *A. planci* and virtually free of soft corals or other macroscopic organisms. Some (Fig. 19) were found on areas of reef face surrounded by algae or soft corals. Large numbers of recolonizers settled on the skeletons which were still *in situ* in many reef areas of coral colonies which had been killed by *A. planci*. The skeletons of tabular acropores, in particular, provided sites for settlement by recolonizing planulae (Fig. 20). However, it was evident that many, if not most, of the recolonizers which had settled on such skeletons would be lost because the skeletons would eventually collapse. This had already occurred in some cases (e.g. at Hall-Thompson Reef and Adelaide Reef).

The results of the surveys carried out at Green Island Reef and Feather Reef supported the tentative findings of Pearson and Endean (1969) that recolonization by hard corals of devastated areas of these reefs was in progress but was not marked. The areas at the southwest and west regions of Green Island Reef examined were invaded by large numbers of A. planci in 1961 and 1962 (Barnes, 1966). It is significant that only slight recolonization was observed in these areas when they were visited in 1970. Likewise, recolonization was only slight at a region on the northwest side when it was visited in 1970. Indeed, of the areas examined at Green Island recolonization was considered to be marked only in shallow water at the southern tip of the reef flat at Green Island Reef and at an area of a reef platform which lay in deeper water at the southeastern side of Green Island Reef. It is noteworthy that the shallow water area at the southern tip of Green Island Reef is a region exposed to considerable wave action and many of the coral colonies growing there had obviously escaped attention from A. planci. Also, a considerable number of colonies on the submerged reef platform at the southeastern side of Green Island Reef had apparently survived the A. planci invasion. According to Barnes (1966) this area showed little evidence of having been attacked by A. planci when it was examined in August, 1966. At Feather Reef recolonization by hard corals in the four areas studied was slight. Both at Feather Reef and at Green Island a high proportion of the recolonizers had settled on tabular acropore skeletons. Soft corals covered extensive areas of Green Island Reef and Feather Reef.

After the bulk of starfish had departed from a reef residual populations of starfish were observed occasionally to continue the destruction of hard corals. For example, in December, 1970 a residual population of starfish was observed to be attacking the few colonies which had escaped destruction on the reef flat at Taylor Reef when this region was invaded by large numbers of A. planci in September, 1969 (Endean and Stablum prec. paper). In January, 1971, starfish were observed on the reef flat at Slashers No.4 Reef attacking corals in an area which appeared to have been devastated by A. planci some months earlier. The surviving portions of colonies apparently damaged during the earlier invasion were being destroyed (Figs. 21, 22 and 23). Specimens of A. planci as small as 12 cm in diameter were found among the attacking starfish. Then too, after the departure of the bulk of invading starfish the destruction of coral in shallow water on the crest of a reef or on the tops of coral pinnacles may be continued in many cases by small juvenile starfish which settle there from the plankton. These juveniles appear to remain in these regions for approximately 12 months before they move into other areas (Endean and Stablum prec. paper). Possibly these young starfish augment the numbers of specimens present in the residual populations of A. planci observed on some devastated reefs. Of interest was the fact that juvenile starfish were found under soft coral colonies near the sand cay at Taylor Reef on 25.5.71.

DISCUSSION

Information on the precise dates when the reefs studied carried large numbers of *A. planci* and the precise dates when the starfish departed from these reefs is not available. However, it is known that infestation of Green Island Reef occurred principally during the first half of the 1960's while infestation of Taylor Reef, reefs of the Slasher Complex and John Brewer Reef occurred towards the end of the decade. When visited during 1970 Yamacutta Reef still carried large numbers of starfish but the windward seaward slopes of Hedley Reef and Potter Reef when visited during 1970 and 1971 respectively showed no signs of having been invaded by large numbers of *A. planci* in recent years. Although most of the other reefs studied during the present investigation carried large numbers of *A. planci* when visited during 1966 (Pearson and Endean, 1969) the condition of the coral cover on most indicated that large numbers of starfish had been active for at least several months prior to the visits. However, available information indicates that the bulk of the invading starfish departed from these reefs during 1967 and 1968 and all appeared to be free of large numbers of *A. planci* by the end of 1969. No information was obtained during the present investigation or during an earlier survey (Endean, 1969; Pearson and Endean, 1969) to suggest that any reef in the area carried large numbers of starfish or had been devastated by starfish prior to the 1960's. On the contrary, information from many sources (shell collectors, fishermen, charter boat operators, divers) indicated that *A. planci* was rarely seen on these reefs and that hard corals flourished on these reefs prior to the 1960's. Since the approximate dates when reefs in the area were devastated by *A. planci* are known and since some reefs were devastated at different times from others an opportunity to study the sequence of events during the recovery of devastated reefs presented itself.

It should be noted that hard corals on all parts of a reef except regions of the reef crest exposed to strong wave action were usually attacked by invading *A. planci*. Also, massive as well as branching corals were attacked. Thus the destruction of hard corals on the reefs visited which were invaded by *A. planci* during the 1960's has been much more extensive and severe than any coral destruction known to have been caused by tropical storms in the area. Indeed, it would seem a reasonable assumption that the bulk of adult *A. planci* departed from such devastated reefs primarily because of a shortage of readily accessible colonies of their hard coral prey. Apart from marked changes in the extent of the live hard coral cover, in the algal cover and in the soft coral cover of reefs invaded by *A. planci* which were studied in this and a previous investigation (Endean and Stablum prec. paper), marked changes in the fish populations of these reefs appear to have occurred. Indeed, it is likely that destruction of the bulk of the hard coral cover of a particular reef will be reflected in marked changes in the populations of all species present on the reef before the starfish invasions.

Recovery of a devastated reef is dependent essentially on the regrowth of a surface cover of hard corals. Such regrowth can stem from an increase in the mean size of surviving undamaged colonies, regeneration and growth of damaged colonies and settlement and growth of new coral colonies. However, full recovery of the hard coral cover would require that this cover be comprised of species and numbers of colonies of each species which are typically found on the type of reef involved in the geographical region where the reef is sited. Further, complete recovery would involve the return of those organisms which are characteristically associated with coral reefs in the region as well as the re-establishment of the complex relationships normally existing between the numerous species comprising the biota of the reef.

The 21 reefs visited in this survey occupy collectively an area of approximately 300 km^2 in flat projection and they are scattered over about 10000 km^2 of sea. Because of the large areas involved, because of the limited time which could be devoted to the study and because of the small number of personnel involved it was not possible to obtain adequate quantitative data to permit a precise assessment of the extent and rate of the recovery of 19 of these reefs from devastation by *A. planci*. However, the quantitative data obtained are generally in accord with visual estimates involving much greater areas of reefs. As can be seen from a study of the data listed in Table 1 and Table 2 the results of the survey are unequivocal. First, coral colonies growing in shallow water in habitats exposed to marked wave action had frequently survived the starfish invasions but elsewhere the amount of surviving hard coral was remarkably small. Indeed, on some reefs (e.g. Sudbury Reef, Howie Reef, Ellison Reef) destruction of the hard coral cover by *A. planci* was almost total. Secondly, some of the surviving coral colonies (e.g. *Millepora* species, *Pocillopora damicornis*, a green species of *Turbinaria*) found in deeper water of reefs from which starfish departed some years ago, had proliferated and spread over adjacent areas. Patches comprised principally of colonies of these species are apparent on some areas of some reefs. No doubt their spread over areas of dead coral skeletons still *in situ* and over areas of coral rubble has been facilitated by the absence of competition for the available substratum by other species of coral. Thirdly, even after the lapse of some years, recolonization by hard corals was generally slight or negligible in the reef areas visited. It is possible that very small colonies were overlooked but it is believed that this is unlikely since in most cases recolonizers attracted attention because they appeared as splashes of colour amid the drab colouration of a devastated reef. Fourthly, there has been a phenomenal increase in the algal cover and in the soft coral cover of vast areas of devastated reefs.

It was apparent that the extent of recovery of the devastated reefs visited varied from reef to reef and from one region to another of the same reef. As might be expected, reefs on which starfish were still active when visited or from which starfish had departed a few months prior to a visit showed no obvious signs of recovery. Although some reefs, such as Gibson Reef, from which the bulk of starfish had departed some years ago showed signs of recovery, other reefs such as Sudbury, Howie and Flora Reefs which had apparently been free of large numbers of *A. planci* for a similar period of time showed negligible recovery, at least in the areas visited. On the other hand, there appeared to be a relationship between the rate of recovery of an area of reef and the extent of coral destruction in that area caused by the starfish initially, the more complete the initial destruction the slower the recovery and vice versa. This raises the possibility that recolonizers on a particular reef are principally the progeny of coral colonies on the same reef which have survived the destruction caused by *A. planci*. If this is the case, then it is likely that recolonization will be fastest on the southeastern side of exposed reefs where pronounced wave action appears to have deterred starfish from attacking coral colonies growing in shallow water habitats.

A reef whose hard coral cover had just been devastated by *A. planci* exhibited a typical picture. Surviving coral colonies were restricted principally to the shallow water near the reef crest and to the tops of coral pinnacles. The skeletons of recently killed corals remained *in situ* but were covered by dark filamentous algae. Occasionally, the tips and/or parts of the branches of branching corals and parts of massive coral colonies growing in deeper water had survived and these damaged colonies gave a characteristic appearance to a reef devastated by *A. planci*. Fish were sparsely represented among the algal covered coral skeletons. After the lapse of one to two years coral skeletons appeared greyish rather than blackish and some had been fragmented or detached. The skeletons of some branching acropores had formed piles of rubble and some tabular acropores had broken away from their points of attachment to the substratum. The growth of surviving portions of acropore colonies was particularly marked at this stage and some of the growth forms assumed were bizarre. Frequently a marked spread of alcyonarians was in evidence by this stage and sometimes vast areas of a reef including the coral skeletons still *in situ* were carpeted by these soft corals.

Within three to four years after starfish had devastated some areas of reef recently settled hard corals were seen in the areas. However, species diversity was low. The principal species among the recolonizers were *Pocillopora damicornis*, *Seriatopora hystrix*, *Stylophora pistillata*, species of *Turbinaria*, *Porites mayeri* and other species of *Porites*, *Acropora hyacinthus*, *A. variabilis*, *A. humilis*, *A. cuneata* and *A. formosa*. It is known that *Pocillopora damicornis*, *Seriatopora hystrix*, and

Stylophora pistillata breed throughout the year (Atoda, 1947a, 1947b, 1951) and possibly they are rapid recolonizers for this reason. At the same time they and the other pioneer recolonizers noted must be particularly tolerant of the changed ecological conditions that are found on reefs which have recently been devastated by A. planci. It is possible that a definite ecological succession will be observed, some of the colonies of the pioneer species being replaced by other species as the reefs recover so that the normal species composition of each reef area is gradually restored.

On the other hand, many of the recolonizing corals had settled on coral skeletons which will ultimately break away from their points of attachment and a high proportion of such recolonizers will be lost. Indeed, the removal of coral skeletons by storms (or by human agency) could well facilitate recolonization. Then too, because of the spread of algae, of alcyonarians and to some extent the spread of hydrozoans such as Millepora spp. the amount of space available for settlement by the planulae of hard corals is restricted in many cases. Certainly no recolonizing corals had obviously settled on soft corals or on living hydrozoans in the areas studied. If these factors are taken into account, as well as others discussed by Endean (in press), it is not surprising that, to date, the recovery of reefs of the Great Barrier Reef devastated by A. planci has been slight. Indeed, it would appear that recovery is likely to be a prolonged process. Moreover, the causes of the A. planci population explosions have not been determined and there would seem to be no reason why recovering reefs will not be reinvaded by large numbers of A. planci particularly as residual populations of A. planci exist on at least some reefs. This raises the possibility that reefs devastated by the A. planci outbreaks may remain impoverished indefinitely. Repeated visits over a period of several years (possibly decades) to marked areas embracing different habitats on a number of reefs which have been devastated by A. planci are required to provide data for an assessment of the probable course of recovery of devastated reefs and the mean length of time which will be required for full recovery of such reefs.

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TABLE 1. REEFS VISITED WITH DETAILS OF AREAS SAMPLED, ESTIMATED DATES OF ATTACK BY *A. PLANCI* ON CORALS IN AREAS SAMPLED, REMARKS ABOUT HARD AND SOFT CORAL COVER AND REMARKS ABOUT RECOLONIZATION

Reef	Type*	Date Visited	Position of Area Examined**	Depth range (m)	Estimated area sampled (m)	Estimated date of attack of area by large numbers of *A. planci*
Arlington	IP	5.11.70	S.E. tip, seaward slope	0 - 5	10,000	?1962 - ?1966
Remarks:	Hard coral sparse. Slight regeneration of damaged *Acropora* colonies. Large areas of soft coral. Negligible recolonization of hard corals. Water turbid. Scarids common.					
Arlington	IP	5.11.70	S.W. side, seaward slope	0 - 5	10,000	?1962 - ?1966
Remarks:	Hard corals sparse. Large areas of soft coral. Negligible recolonization of hard corals. Water turbid.					
Green	IP	2.5.70	W. of cay, reef flat	0 - 5	10,000	1962 - 1964
Remarks:	Hard corals sparse. Soft coral cover extensive. Water turbid. Recolonization slight. A few tabular acropores about 10 cm in diameter on sides of skeletons of massive corals noted.					
Green	IP	6.11.70	N.W. side, reef flat	0 - 3	5,000	1963 - 1964
Remarks:	Hard corals sparse. Soft coral cover extensive. Negligible recolonization. Water turbid.					
Green	IP	6.11.70	S.W. side, seaward slope	0 - 15	5,000	1961 - 1963
Remarks:	Remarkably few hard corals had survived. *Pocillopora damicornis* in patches attached to broken acropore rubble. Very little recolonization. A few recolonizing *Acropora* species seen. Soft corals prominent.					
Green	IP	6.11.70	S.W. side, seaward slope	0 - 15	5,000	1961 - 1963
Remarks:	Hard corals sparse. Banks of rubble. Very little recolonization. Water turbid.					

* OP = outer patch reef; IP = inner patch reef.

** N. = north; S. = south; E. = east; W. = west.

Table 1 cont'd.

Green	IP	6.11.70	S. side, seaward slope	0 - 15	5,000	1961 - 1963
Remarks:	Scattered surviving corals in shallow water. Some regenerating. Among survivors in deeper water were large clumps of *Millepora tenera*, *Millepora platyphylla* and *Heliopora caerulea*. Among recolonizers noted were *Acropora lyacinthus*, *Acropora variabilis*, *Acropora formosa*, *Acropora corymbosa*, *Seriatopora hystrix*, *Pocillopora damicornis*, *Stylophora pistillata*, *Montipora foliosa*, *Porites andrewsi*, and an unidentified species of *Turbinaria*. Rubble covered in some areas by fleshy algae and soft corals.					
Green	IP	6.11.70	S.E. side, submerged reef	3 - 10	10,000	? 1962
Remarks:	Surface covered by soft corals interspersed with hard corals some of which had obviously survived starfish population explosions, others of which appeared to be recolonizers. The dominant coral was a green species of *Turbinaria*. *Stylophora pistillata* and *Pocillopora damicornis* occured in patches. Water turbid.					
Hedley	OP	3.11.70	S.E. tip, seaward slope	0 - 15	10,000	-
Remarks:	Hard coral cover extensive. No coral damage due to *A. planci* observed.					
Hedley	OP	3.11.70	N.E. tip, seaward slope	0 - 15	10,000	-
Remarks:	Hard coral cover extensive.					
Gibson	IP	3.11.70	S.E. side, seaward slope	0 - 10	5,000	?1963 - ?1967
Remarks:	Some massive and branching corals had survived. Soft corals common. Recolonization marked but some recolonizers on dead tabular *Acropora*.					
McCulloch	IP	3.11.70	W. side, seaward slope	0 - 15	3,000	?1963 - ?1967
Remarks:	Remarkably few hard corals had survived. Soft corals common. No recolonization detected. Fish sparse.					
McCulloch	IP	3.11.70	N.E. tip, seaward slope	0 - 5	3,000	?1963 - ?1967
Remarks:	Remarkably few hard corals had survived. Soft corals common. No recolonization detected. Fish sparse.					
Howie	IP	1.5.70	S. tip, lagoon bombie	0 - 5	500	?1963 - ?1967
Remarks:	Very few hard corals had survived. Soft corals common. No recolonization detected.					

Table 1 cont'd.

Reef	Type	Date Visited	Area examined	Depth	Area sampled	Est. date of attack
Howie	IP	2.11.70	W. side, lagoon near centre of reef	0 - 5	500	?1963 - ?1967
Remarks:	Remarkably few hard corals had survived. No recolonization detected. Water very turbid. Few fish seen.					
Sudbury	IP	2.5.70	N.W. side, seaward slope	0 - 5	10,000	?1963 - ?1967
Remarks:	Very few hard corals had survived. No recolonization detected.					
Sudbury	IP	6.11.70	N.W. of cay, reef flat	0 - 3	10,000	?1963 - ?1967
Remarks:	Remarkably few hard corals had survived. No recolonization detected. Soft coral cover extensive. Water turbid.					
Sudbury	IP	6.11.70	W. side, seaward slope	0 - 10	7,000	?1963 - ?1967
Remarks:	Remarkably few hard corals had survived. Some regeneration of surviving Acropora noted. No recolonization by hard corals detected. Water turbid. Scarids common.					
Flora	IP	7.11.70	S.E. side, seaward slope	0 - 5	10,000	?1963 - ?1967
Remarks:	A few hard corals had survived near reef crest. Remarkably few hard corals in deeper water. Some recolonization detected.					
Flora	IP	7.11.70	S.W. side, seaward slope	0 - 5	7,000	?1963 - ?1967
Remarks:	Remarkably few hard corals had survived. No recolonization detected.					
Cayley	IP	2.11.70	S.W. tip, seaward slope	0 - 10	2,000	?1963 - ?1967
Remarks:	Some hard corals, particularly large Porites, had survived. Some recolonization particularly by Porites obvious.					
Cayley	IP	2.11.70	W. side, seaward slope	0 - 10	5,000	?1963 - ?1967
Remarks:	A few patches of hard corals had survived. Recolonization slight.					

Table 1 cont'd.

Feather	IP	2.11.70	N. tip, seaward slope	0 - 12	5,000	1966
Remarks:	Few hard coral colonies had survived. *Millepora platphylla* occurred in clumps. Soft coral cover extensive. Recolonization by hard corals slight. Among recolonizers noted were *Acropora humilis*, *Acropora variabilis*, *Porites mayeri*, an unidentified yellowish green species of *Porites*, *Pocillopora verucosa*, *Pocillopora damicornis* and *Seriatopora hystrix*. Many recolonizers had settled on skeletons of tabular acropores.					
Feather	IP	2.11.70	E. side, seaward slope	0 - 12	5,000	?1963 - ?1967
Remarks:	Few hard corals had survived. Among survivors were the hydrozoans *Heliopora caerulea* and *Distichopora fisheri*. Soft coral cover extensive. Recolonization by hard corals slight. Among recolonizers noted were *Acropora hyacinthus*, *Acropora variabilis*, *Acropora humilis*, *Acropora cuneata*, *Acropora squamosa*, *Pocillopora damicornis*, *Seriatopora hystrix*, *Porites mayeri* and an unidentified greenish species of *Porites*. *Pocillopora damicornis* was the dominant coral. Many recolonizers had settled on skeletons of tabular acropores.					
Feather	IP	2.11.70	E. side, seaward slope	0 - 12	5,000	?1963 - ?1967
Remarks:	Few hard corals had survived. Patches of *Millepora platyphylla* found. Soft coral cover extensive. Recolonization slight. Among recolonizers noted were *Acropora hyacinthus*, *Acropora cuneata*, *Acropora digitifera*, *Acropora variabilis*, *Acropora humilis*, *Pocillopora damicornis*, *Seriatopora hystrix*, *Porites mayeri* and an unidentified greenish species of *Porites*. Many recolonizers had settled on skeletons of tabular acropores.					
Feather	IP	2.11.70	E. side, seaward slope	0 - 12	5,000	?1963 - ?1967
Remarks:	Few hard corals had survived. Soft coral cover extensive. Recolonization slight. *Acropora*, *Pocillopora* and *Porites* prominent among recolonizers.					
Hall-Thompson	IP	24.5.71	S. side, lagoon	0 - 10	10,000	?1963 - ?1967
Remarks:	Very few hard corals had survived. Marked growth of soft corals, estimated 30% cover. Recolonization of hard corals slight. *Stylophora pistillata*, *Pocillopora damicornis* and *Porites mayeri* were prominent among recolonizers. Water turbid. Few fish seen.					

Table 1 cont'd.

Reef	Type	Date Visited	Area examined	Depth	Area sampled	Est. date of attack
Hall-Thompson	IP	24.5.71	E. side, seaward slope	0 - 15	10,000	?1963 - ?1967
Remarks:	Few hard corals had survived. Estimated 15% soft coral cover. Some recolonization by hard corals. Stylophora pistillata, Pocillopora damicornis, and a green Turbinaria species were prominent among recolonizers. A few colonies of Porites lutea, Porites lobata, Acropora spp. and Cyphastrea serailia were seen but most of these had settled on the skeletons of tabular acropores. Fish were rarely seen.					
Adelaide	IP	24.5.71	Middle, N. side, lagoon	0 - 6	10,000	?1963 - ?1967
Remarks:	Remarkably few hard corals had survived. Soft corals prominent. Very little recolonization of hard corals. Small clumps of Seriatopora hystrix and Pocillopora damicornis were found as well as a few colonies of Porites spp. and Acropora spp. Skeletons of tabular acropores torn loose and heaped at bases of coral pinnacles.					
Adelaide	IP	24.5.71	N.E. tip, seaward slope	0 - 15	7,000	?1963 - ?1967
Remarks:	A few massive as well as branching coral colonies had survived. Some regeneration of surviving acropores noted. Some recolonization, particularly of species of Acropora, Stylophora pistillata and Pocillopora damicornis apparent. Patches of green Turbinaria prominent. A few recently established colonies of Porites mayeri, Symphyllia nobilis and one colony of Platygyra sinensis were noted. Soft coral cover estimated at 5%. Fish were very scarce.					
Potter	OP	24.5.71	Middle of reef, lagoon	0 - 10	10,000	?1967 - ?1969
Remarks:	Remarkably few hard corals had survived. Soft corals common. No recolonization by hard corals observed.					
Potter	OP	24.5.71	N.E. side, seaward slope	0 - 20	15,000	-
Remarks:	Hard coral growth luxuriant. No coral damage due to starfish observed.					
Ellison	IP	28.5.71	S.W. side, back reef area	3 - 10	10,000	?1964 - ?1969
Remarks:	Remarkably few hard corals had survived. Recolonization of hard corals slight. A few colonies of Acropora (A. hyacinthus, A. microphthalma, A. affinis, A. humilis, A. corymbosa), Pocillopora and Porites were seen. Water turbid.					

Table 1 cont'd.

Eddy	IP	28.12.70	W. side, seaward slope	0 - 3	5,000	?1964 - ?1969
Remarks:	Remarkably few hard corals had survived. Some regeneration of surviving Acropora and Pocillopora colonies. No recolonization detected.					
Eddy	IP	28.12.70	S. tip, seaward slope	0 - 10	5,000	?1964 - ?1969
Remarks:	A few massive Porites had survived but living hard corals were generally sparse. No recolonization detected.					
Taylor	IP	28.1.70	S. of cay, reef flat	0 - 2	100,000	?1967 - 1970
Remarks:	Very few corals had survived. A few starfish still present. No recolonization.					
Taylor	IP	30.12.70	N.W. side, lagoon near cay	0 - 3	15,000	?1967 - 1970
Remarks:	A few surviving clumps of Pocillopora seen. No recolonization. Soft corals blanketed large areas. A small population of A. planci (adults and juveniles) present.					
Taylor	IP	31.12.70	N. side, seaward slope	0 - 5	20,000	?1967 - 1970
Remarks:	A few clusters of coral colonies had survived in shallow water and some massive Porites in deeper water. No recolonization detected.					
Taylor	IP	31.12.70	S. side, seaward slope	0 - 15	15,000	?1967 - 1970
Remarks:	Most corals near reef crest had survived. Corals dead from 3 - 4 metres below crest to sea floor. No recolonization detected.					
Taylor	IP	25.5.71	W. side, lagoon near cay	0 - 6	10,000	?1967 - 1970
Remarks:	No surviving hard corals detected. No recolonization. Soft coral cover extensive, estimated 60% cover.					
Beaver	IP	29.12.70	W. of cay, seaward slope	0 - 10	10,000	?1966 - 1970
Remarks:	Remarkably few hard corals had survived. Some regeneration of tips of surviving acropores. No recolonization detected. Soft corals blanketed large areas.					
Beaver	IP	29.12.70	N.E. tip, seaward slope	0 - 15	10,000	?1966 - 1970
Remarks:	Clumps of hard coral in shallow water on the reef flat and on tops of coral pinnacles had survived but living hard corals sparse elsewhere. No recolonization detected. Damaged acropores were regenerating.					
"Yamacutta"	IP	2.1.71	N. side, seaward slope	0 - 3	5,000	?1967 - 1970
Remarks:	Only scattered Pocillopora colonies had survived. No recolonization detected. Soft corals prominent.					

Table 1 cont'd.

Reef	Type	Date Visited	Area examined	Depth	Area sampled	Est. date of attack
"Yamacutta"	IP	25.5.71	N. side, lagoon	0 - 15	10,000	?1967 - 1970
Remarks:	Surviving corals confined to tops of bombies. Some small clumps of *Stylophora mordax* considered to be recolonizers were noted on sides of bombies.					
"Yamacutta"	IP	25.5.71	E. side, seaward slope	0 - 20	500	?1967 - 1970
Remarks:	No surviving hard corals detected. No recolonization detected.					
"Yamacutta"	IP	25.5.71	E. side, seaward slope	0 - 20	500	?1967 - 1970
Remarks:	Surviving corals in scattered patches in upper six metres of reef. No survivors in deeper water. No recolonization detected.					
"Yamacutta"	IP	25.5.71	S.E. side, seaward slope	0 - 20	5,000	?1967 - 1970
Remarks:	The majority of hard corals in upper 15 metres had survived. No survivors in deeper water.					
"Yamacutta"	IP	25.5.71	N.E. tip, seaward slope	0 - 15	15,000	?1967 - 1970
Remarks:	Hard corals in upper 3 metres mostly alive. Few survivors in deeper water. No recolonization detected.					
Slashers No. 1	IP	17.8.70	W. of cay, reef flat	0 - 2	80,000	1970
Remarks:	Hard corals under attack by starfish.					
Slashers No. 1	IP	30.10.70	W. of cay, reef flat	0 - 2	45,000	1970
Remarks:	Surviving corals under attack by starfish. Most coral skeletons in area algal covered.					
Slashers No. 4	IP	27.1.71	W. side, reef flat	0 - 2	3,000	?1968 - 1971
Remarks:	Surviving hard corals under attack by starfish.					
John Brewer	IP	16.8.70	W. side, seaward slope	0 - 5	3,000	1969 - 1970
Remarks:	Hard corals in shallow water under attack by starfish. Very few surviving corals in deeper water. No recolonization detected.					

Table 1 cont'd.

John Brewer	IP	26.1.71	S.E. side, seaward slope	0 - 15	100,000	1969 - 1970
Remarks:	Hard corals on reef crest had survived but almost all corals in deeper water except massive *Porites* and *Astreopora* had been killed. No recolonization detected.					
John Brewer	IP	26.1.71	E. side, seaward slope	0 - 15	10,000	1969 - 1970
Remarks:	Most corals on reef crest had survived. Remarkably few coral colonies in deeper water had survived. No recolonization detected.					
John Brewer	IP	26.1.71	N.W. side, seaward slope	0 - 15	5,000	1960 - 1970
Remarks:	Most corals on reef crest had survived. Remarkably few coral colonies in deeper water had survived. No recolonization detected.					

TABLE 2. POSITIONS OF TRANSECTS AND DATA ON REEF COVER FROM QUADRAT SAMPLING

Reef	Date	Type	Position	No. of quadrat prints	% LHC* cover (mean)	% recently established colonies in LHC	% SC+ cover (mean)	% ADS++ (mean)	No. of recently established colonies per print (mean)	No. of surviving colonies per print (mean)
Green	6.11.70	IP	S. W. side, seaward slope	11	5.5	27.6	5.6	88.8	0.6	1.5
Green	6.11.70	IP	S. W. side, seaward slope	11	1.9	46.3	9.5	88.6	0.7	0.5
Green	6.11.70	IP	S. side, seaward slope	11	15.6	47.9	11.6	72.7	2.8	1
Green	6.11.70	IP	S. E. side, submerged reef	10	18.3	45.9	20.8	60.9	1.1	0.6
Hedley	3.11.70	OP	N. E. tip, seaward slope	11	55.9	-	5.9	38.2	-	7.2
Gibson	3.11.70	IP	S. E. side, seaward slope	5	11.8	57.2	11.2	77.0	6.6	2.6
Feather	2.11.70	IP	N. tip, seaward slope	11	2.1	50	1.0	96.9	0.7	1.2

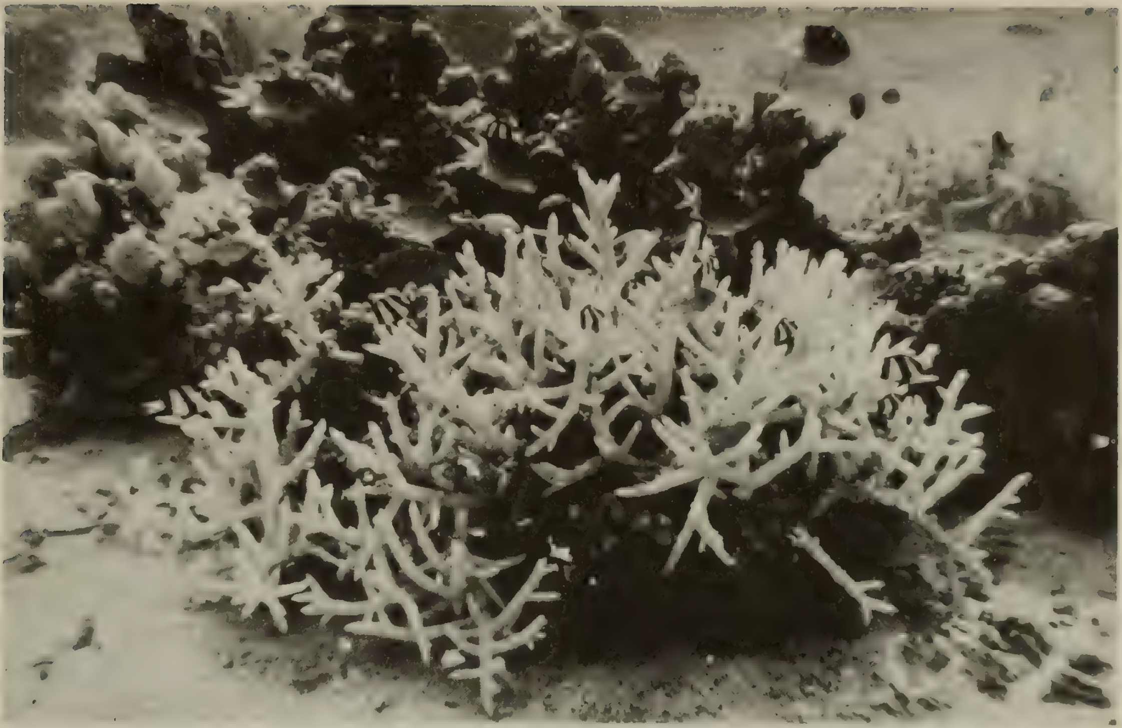
* LHC = Live hard coral; + SC = Soft coral; ++ ADS = Algal dominated substratum.

Table 2 cont'd.

Feather	2.11.70	IP	E. side, seaward slope	11	4.9	75.6	12.4	82.7	3.0	0.3
Feather	2.11.70	IP	E. side, seaward slope	11	4.2	70.8	23.8	72.0	1.3	0.6
Feather	2.11.70	IP	E. side, seaward slope	11	4.0	77.6	21.5	74.5	2.6	0.8
Hall-Thompson	24.5.71	IP	E. side, seaward slope	9	9.5	16.7	10.3	80.2	1.5	0.5
Adelaide	24.5.71	IP	N. E. tip, seaward slope	8	10.3	23.1	4.4	85.3	2.3	1.2
Potter	24.5.71	OP	N. E. side, seaward slope	13	47.2	-	4.0	48.8	-	6.5
Ellison	28.5.71	IP	S. W. side, back reef area	11	5.8	67.6	0	94.2	2.3	0.2
Ellison	28.5.71	IP	S. W. side, back reef area	12	2.8	100	0	97.2	2.5	0
Yamacutta	25.5.71	IP	N. E. tip, crest and reef flat	7	26.2	-	18.6	55.2	-	6.5
Slashers No. 1	17.8.70	IP	W. of cay, reef flat	16	4.6	-	0	95.4	-	0.8
John Brewer	26.1.71	IP	E. side, seaward slope	6	0	-	1.5	98.5	-	0.0
John Brewer	26.1.71	IP	E. side, seaward slope	6	0.7	-	0	99.3	-	0.3

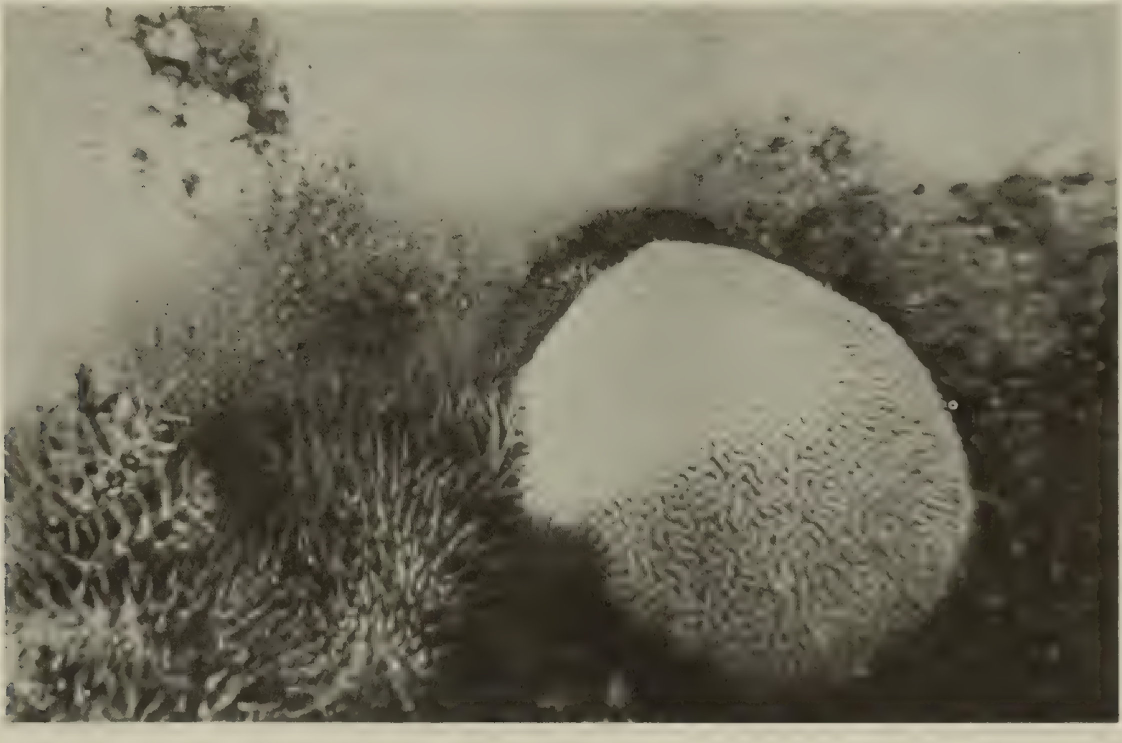
TABLE 3. DIAMETERS OF SOME MASSIVE CORAL COLONIES KILLED BY *A. PLANCI* ON THE REEF FLAT AT SLASHERS NO. 1 REEF IN AUGUST, 1970.

Genus	Diameter of colonies (cm)
Symphyllia	92, 56, 24.
Favia	25, 28.
Favites	56, 52.
Goniastrea	26, 28, 19.
Oulophyllia	53.
Platygyra	57, 54, 58, 53, 67.
Astreopora	31, 47.
Goniopora	23, 32.
Porites	49, 53, 42.



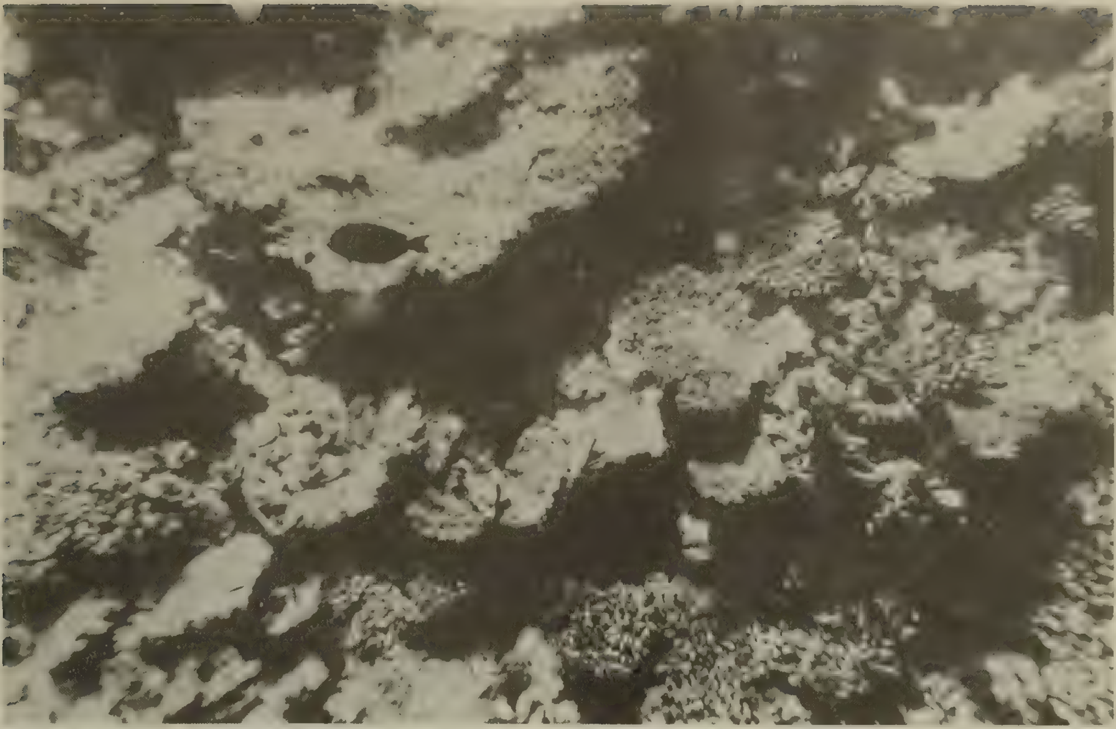
2 The white exposed skeleton of an acropore colony which had just been killed by Acanthaster planci (Slashers No. 1 Reef; August, 1970).

3 The white exposed skeleton of a colony of a species of Platygyra which has just been killed by specimens of Acanthaster planci visible to the left of the colony (Slashers No.4 Reef; January, 1971).



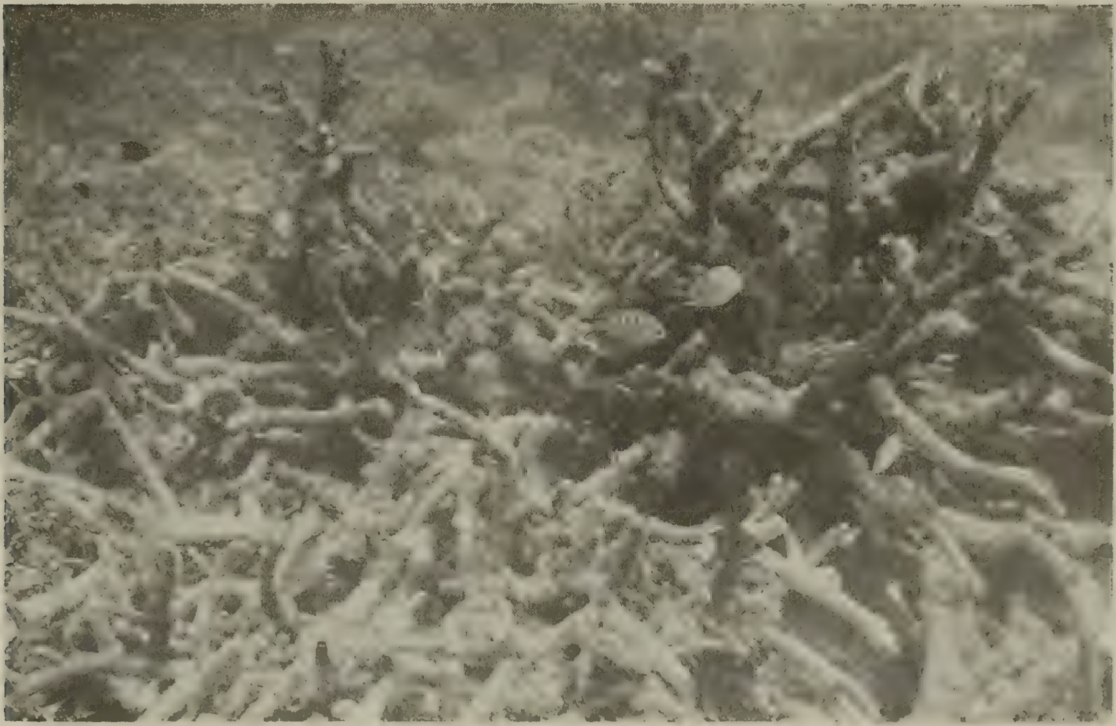
4 The skeleton of a branching acropore believed to have been killed some weeks earlier when large numbers of A. planci invaded this region of the reef flat at Taylor Reef. Dark filamentous algae cover much of the skeleton (January, 1970).

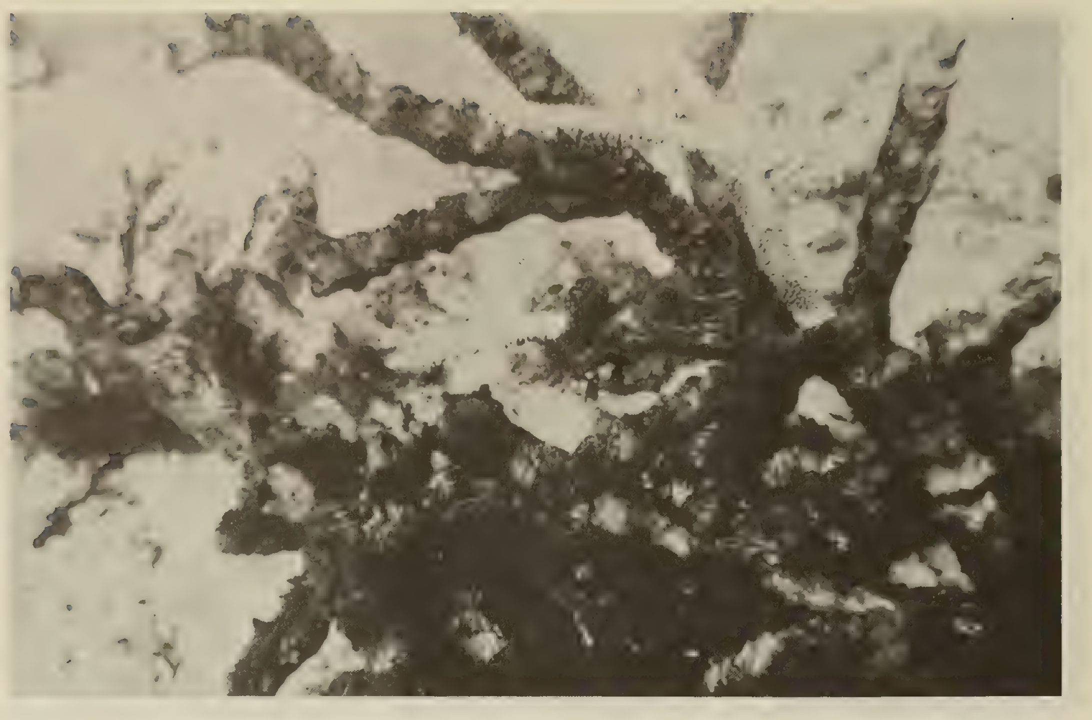
5 The algal covered skeleton of a massive coral believed to have been killed by A. planci some months previously (lagoon, Yamacutta Reef; May, 1971).



6 Portion of the reef face on the seaward slope at the eastern side of John Brewer Reef showing the algal covered skeletons of tabular acropores and other corals still in situ (January, 1971). Large numbers of A. planci were active in the area in 1970.

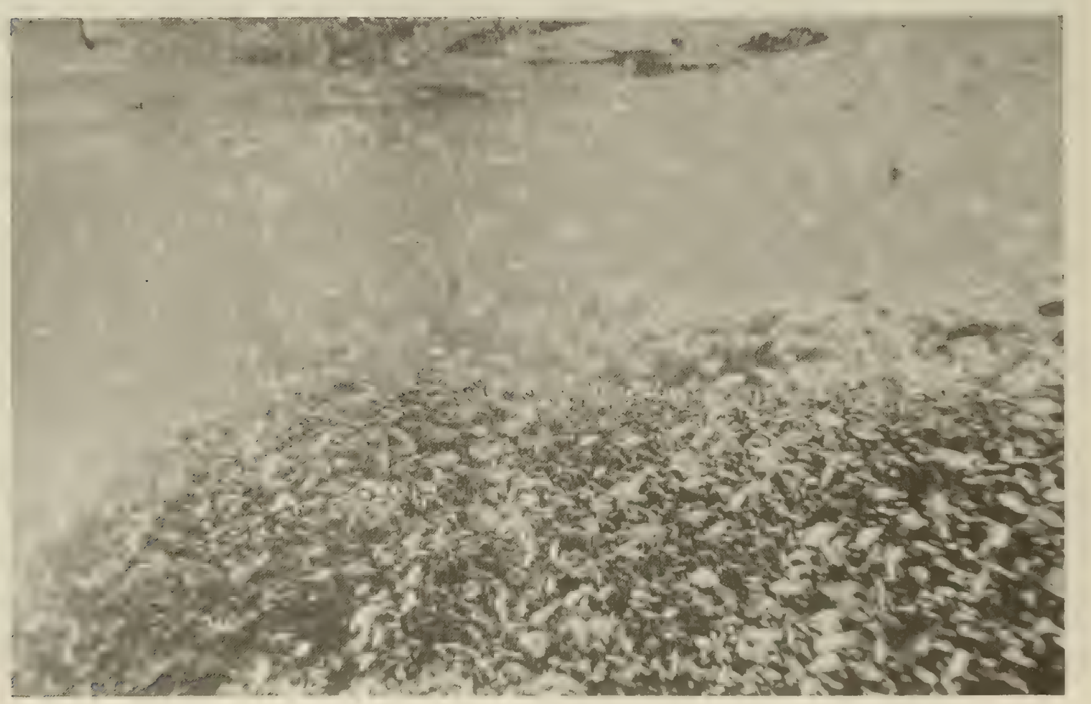
7 Smashed skeletons of acropore colonies on the seaward slope, eastern side of Hall-Thompson Reef (May, 1971).

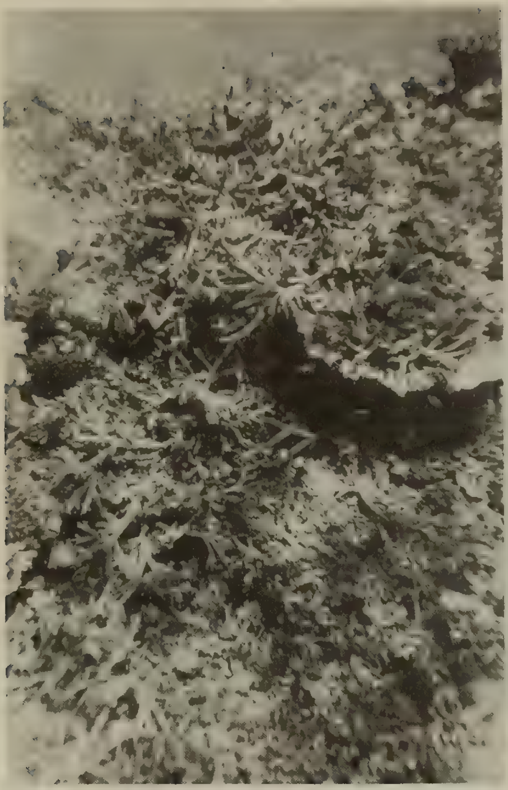




8 Large numbers of fish aggregated in the vicinity of one of the few large acropore colonies which had survived the *A. planci* invasions of the reef flat at Slashers No.4 Reef (January, 1971).

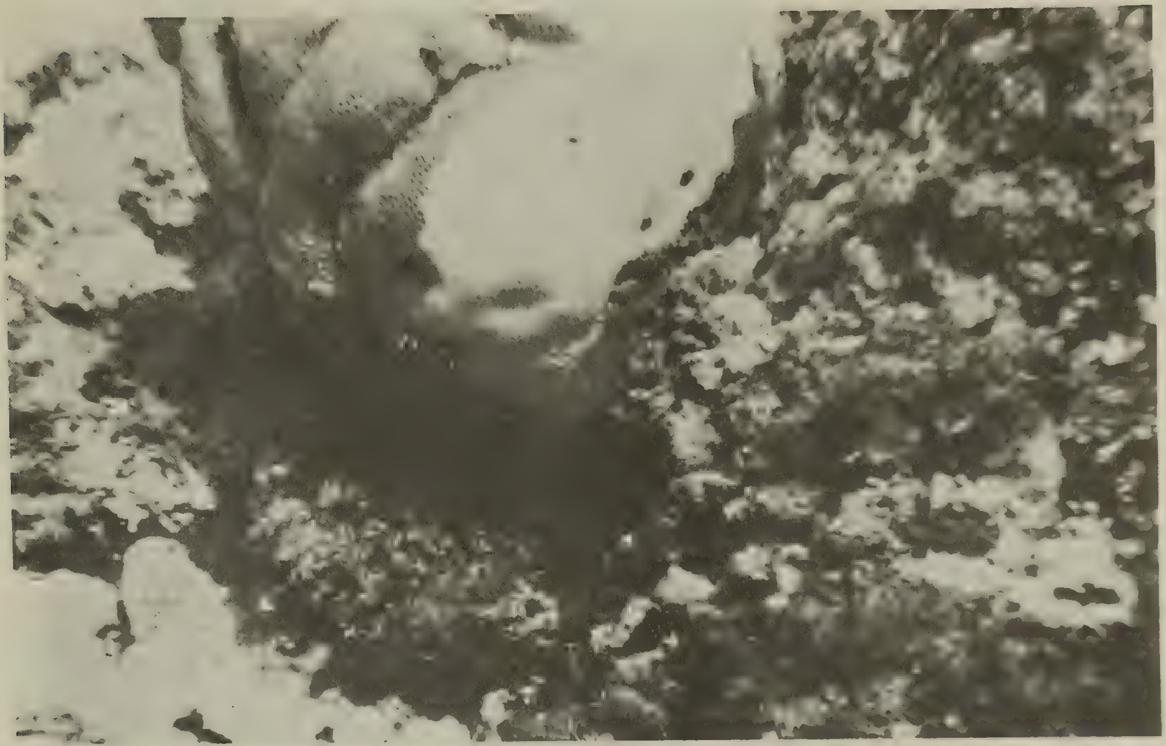
9 Part of a damaged colony of a species of *Acropora*. Living tissue has been stripped from the bulk of the skeleton which is covered with dark algae. Surviving polyps are present on the tips of two branches which are free of fouling algae (reef flat, Slashers No.4 Reef; January, 1971).

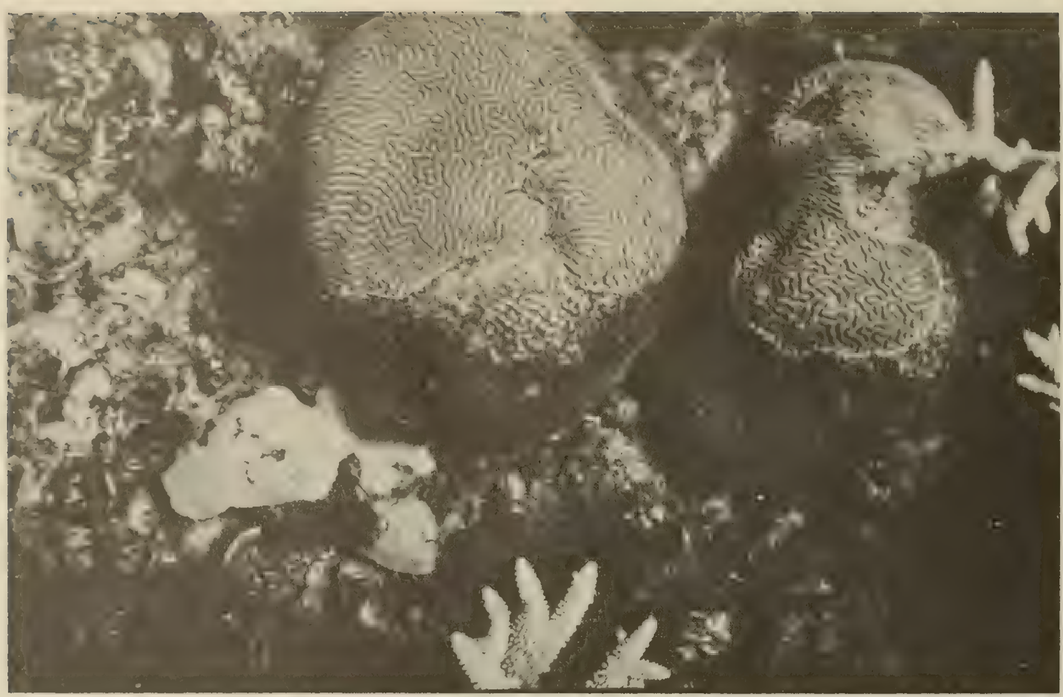




10 Partially damaged colonies of staghorn acropores many of which have collapsed owing to fracture of regions of the skeleton from which living tissue had been removed some months earlier apparently by A. planci (north side, seaward slope, McCulloch Reef; July, 1971).

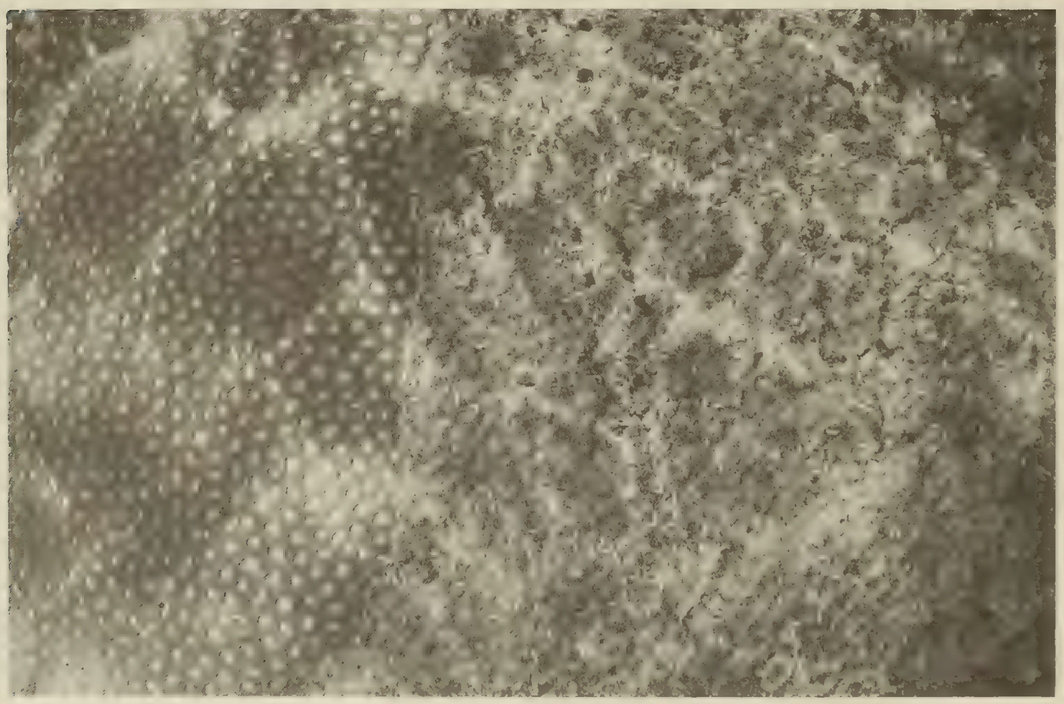
11 The white freshly exposed skeleton of part of this massive coral colony marks the passage of a feeding A. planci (Slashers No.4

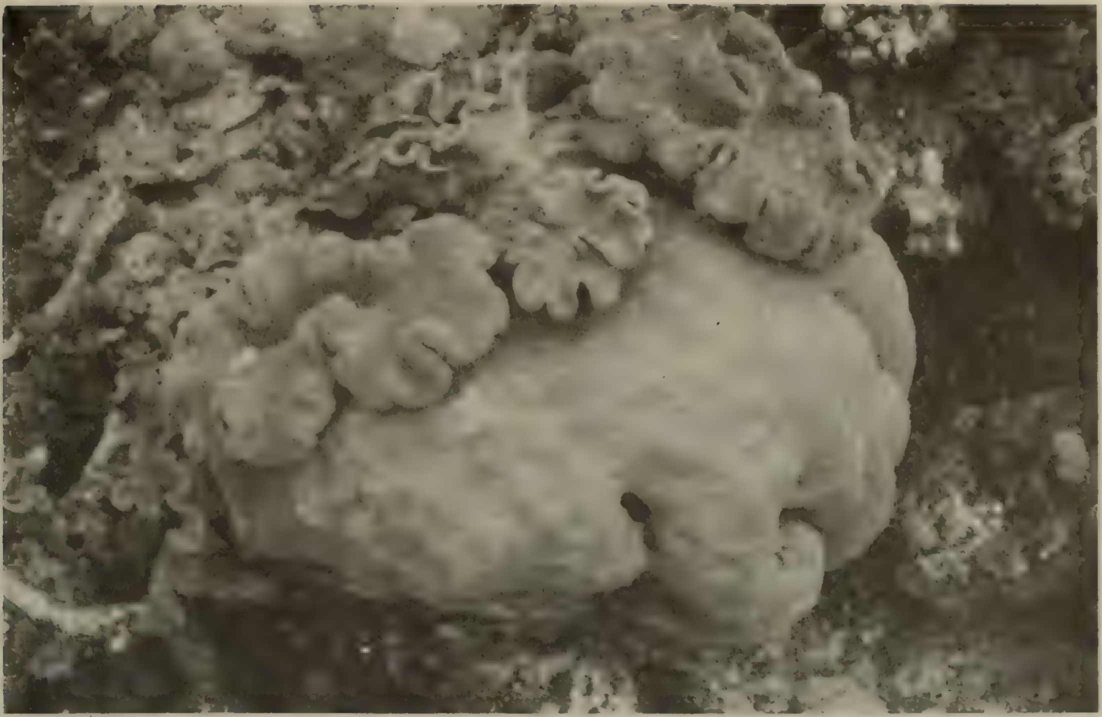




12 Two partially damaged colonies of a species of massive coral (probably Leptoria phrygia). Damaged portions are covered with black fouling algae (Yamacutta Reef; May, 1971).

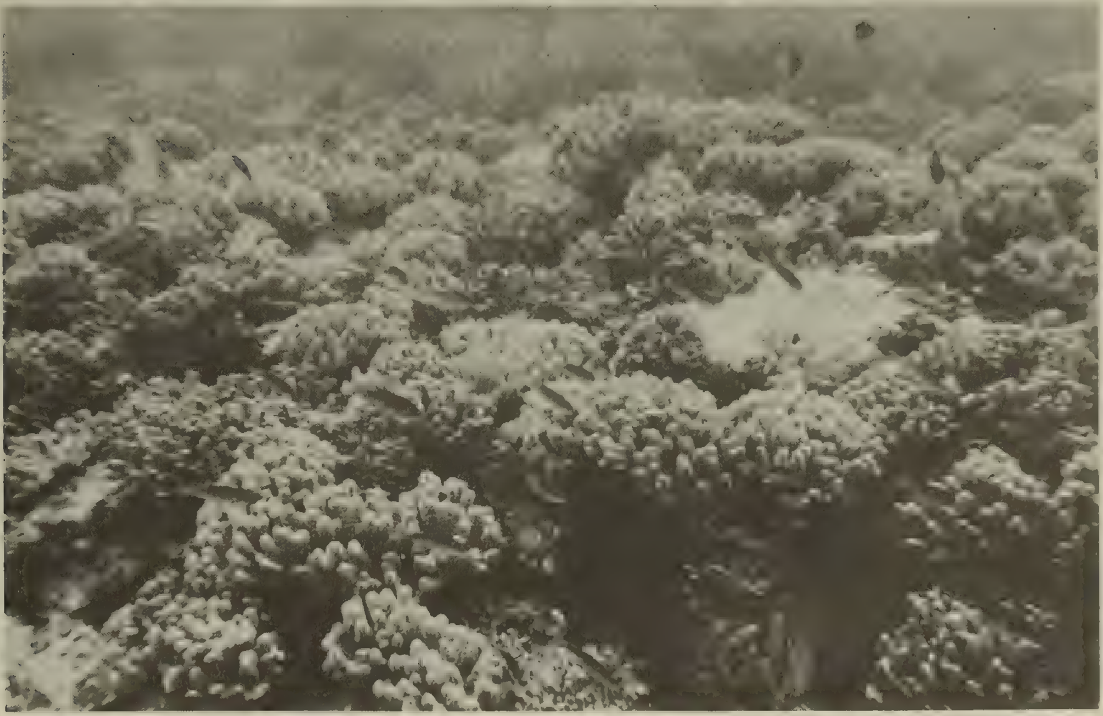
13 Portion of a damaged colony of a species of Favia. Living coral polyps are visible on the left side of the colony. The living tissue had been removed from the remainder of the colony several months earlier by A. planci which is known to have been active in the area (seaward slope, Hall-Thompson Reef; May, 1971).





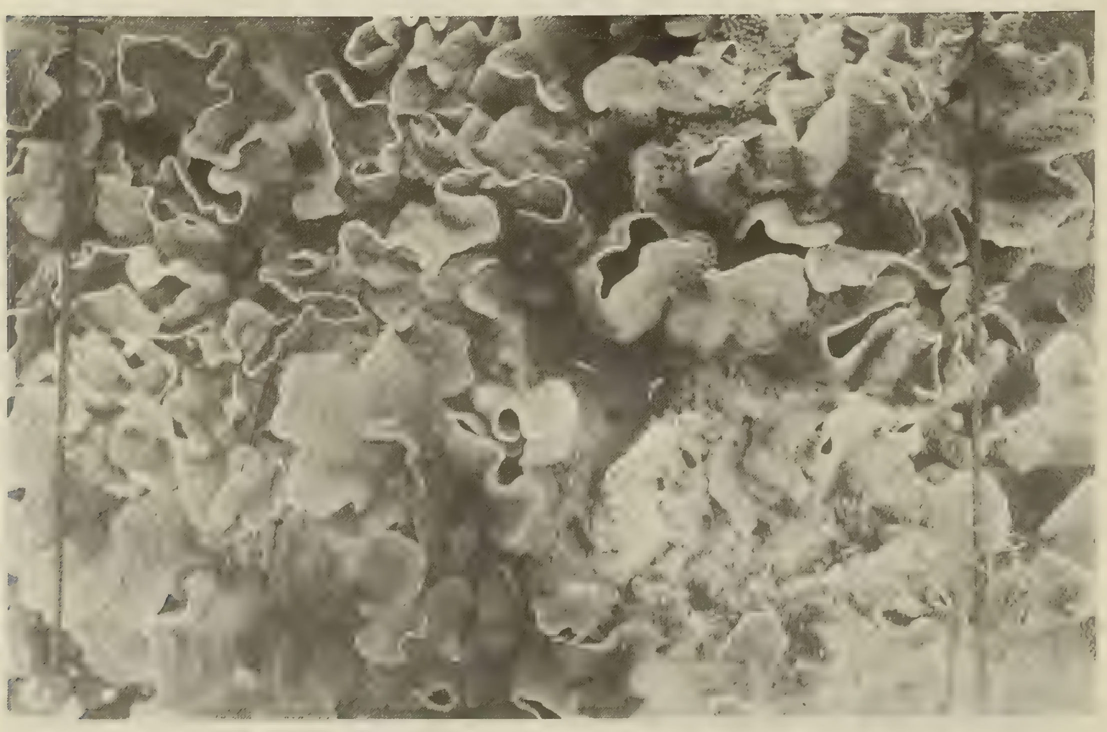
14 A damaged colony of a species of Porites showing colonies of alcyonarians growing on part of the exposed skeleton of the colony (south-east side, seaward slope, Green Island Reef; November, 1970).

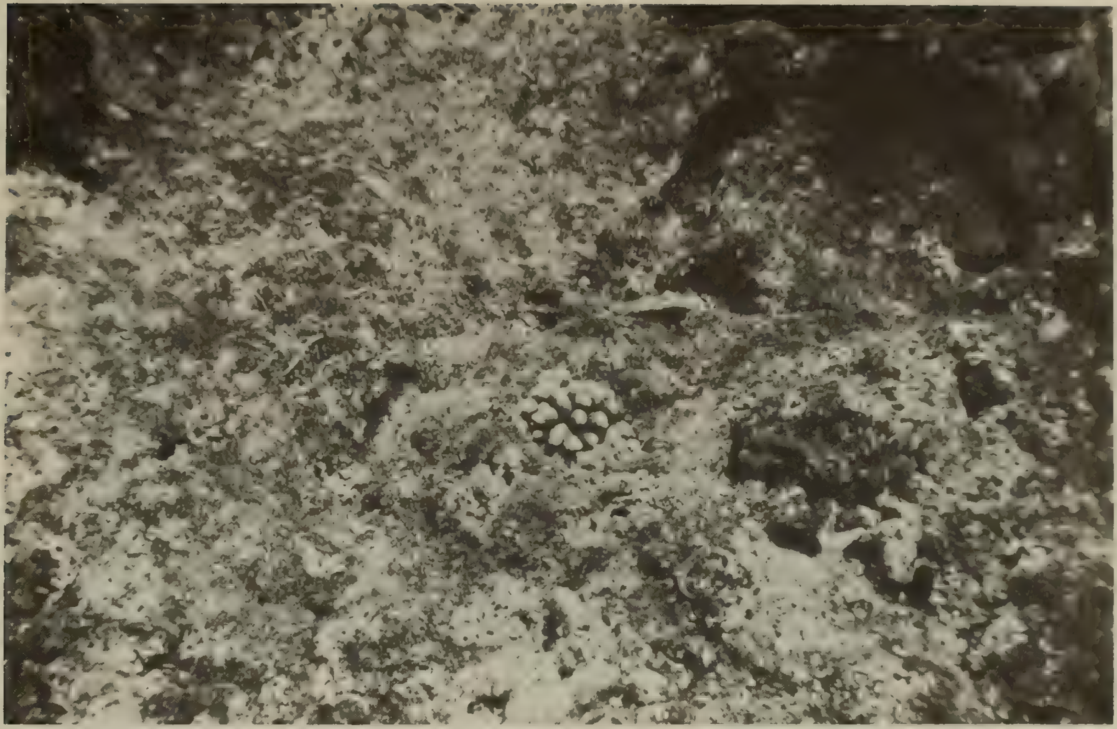
15 Soft corals growing on the skeletons still in situ of hard corals believed to have been killed by A. planci about 1966 (northern tip, Feather Reef; July, 1971).



16 Colonies of soft corals forming a carpet over coral skeletons lying on floor of west side of lagoon at Taylor Reef (May, 1971). Starfish are known to have been active in the area in 1969.

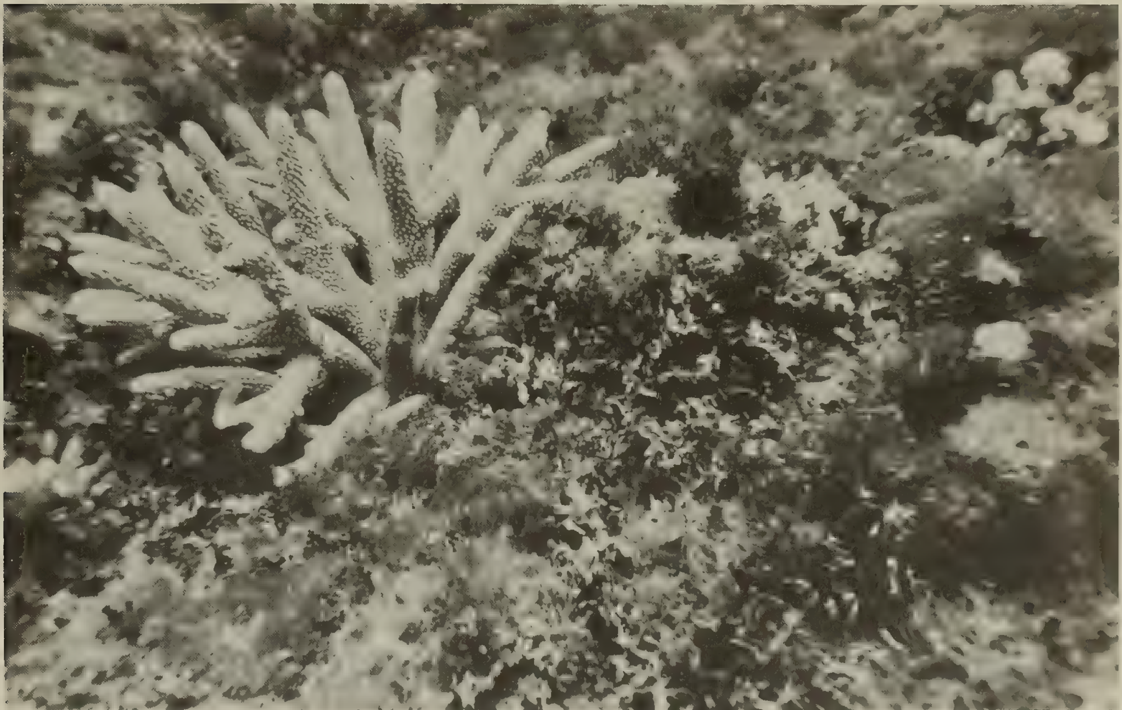
17 A patch of a green species of Turbinaria partially enclosed by a quadrat frame photographed on the southeastern side, seaward slope of Green Island Reef (November, 1970).

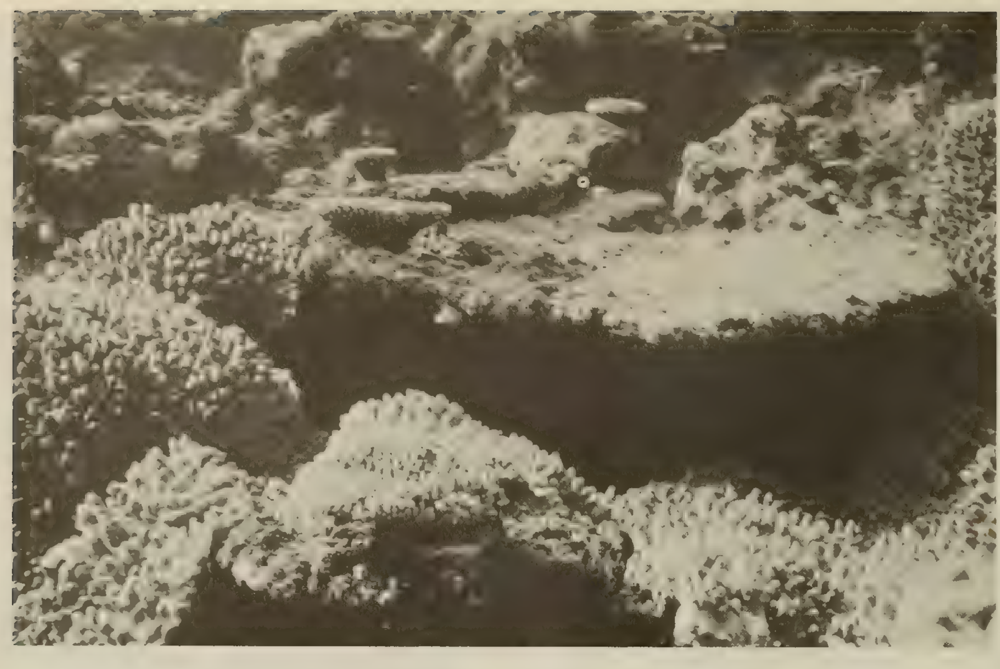




18 A recently settled colony of Acropora humilis on a "clean" reef surface (back reef area, Ellison Reef; May, 1971).

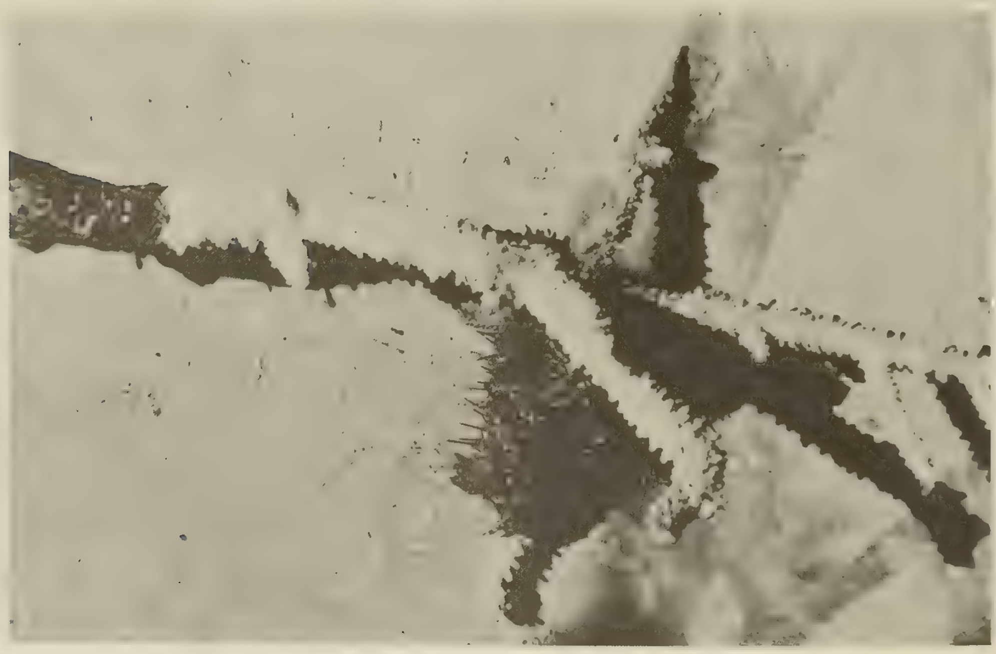
19 A colony of a species of Acropora estimated to have settled in 1968 or 1969 on the seaward slope, north side of McCulloch Reef. The colony is surrounded by algae (July, 1971).

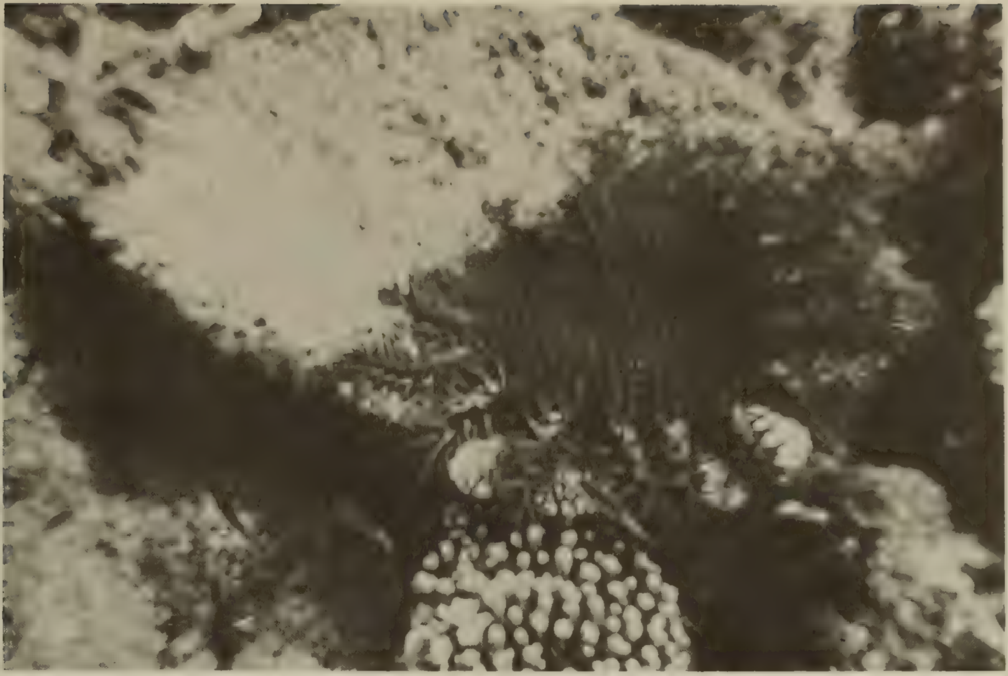




20 A tabular acropore skeleton carrying a recently settled colony of Acropora hyacinthus is shown near the centre of the photograph. Soft corals cover other hard coral skeletons in the foreground. Starfish were active in the area in 1966 (northern tip, seaward slope, Feather Reef; November, 1970).

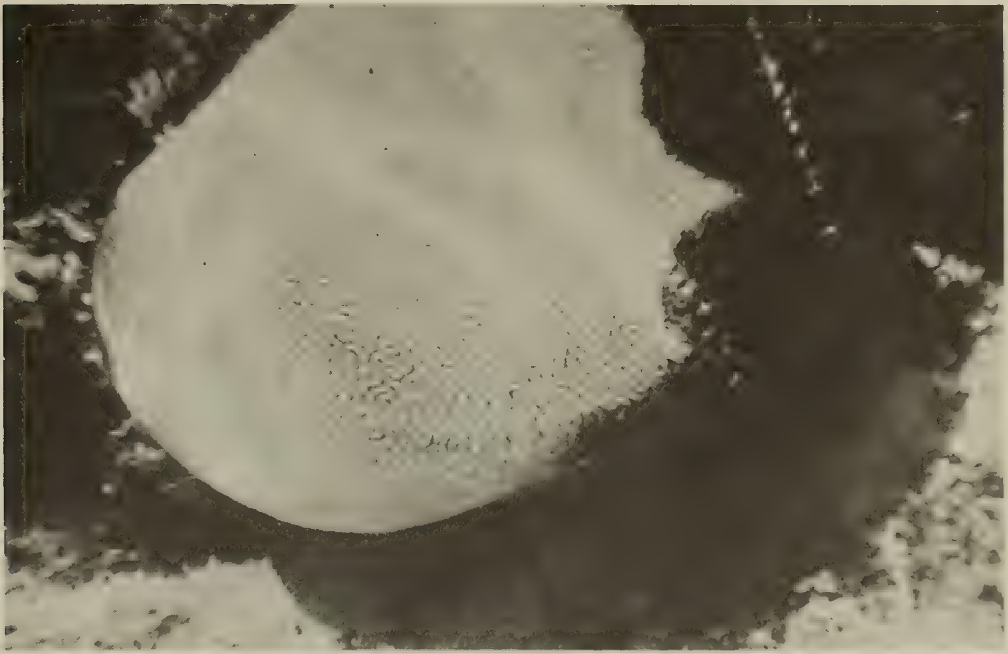
21 Portion of a branch of an acropore colony being attacked by a specimen of A. planci. The basal portion of the branch (to the left) was algal covered and was considered to have been stripped of living coral tissue by starfish some months earlier (reef flat, Slashers No.4 Reef; January, 1971).





22 A specimen of A. planci attacking part of the edge of a tabular acropore which had survived earlier devastation of the rest of the colony and had continued to grow (Taylor Reef; January, 1970).

23 The white, freshly exposed skeleton of portion of a colony of a species of Platygyra which had survived the earlier destruction of the remainder of the colony. The remainder of the colony is covered with dark algae and is estimated to have been killed some weeks earlier probably by A. planci (reef flat, Slashers No.4 Reef; January, 1971).



ATOLL RESEARCH BULLETIN

NO. 169

INVESTIGATIONS OF ACANTHASTER PLANCI IN SOUTHEASTERN POLYNESIA DURING 1970-1971

by Dennis M. Devaney and John E. Randall

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Contents

Page

Introduction 1
Duke of Gloucester Group, Tuamotu Archipelago 2
  Anuanuraro Atoll 2
Gambier or Mangareva Group, Tuamotu Archipelago 2
Pitcairn Group 4
  Oeno Atoll 4
  Pitcairn Island 4
  Henderson Island 5
  Ducie Atoll 5
Rapa and Ilots de Bass 7
The Austral Islands 7
Southern Cook Islands 8
  Manuae (Hervey) 8
  Aitutaki 8
  Rarotonga 10
Society Islands 14
  Bora Bora 14
  Huahine 14
  Tahiti 15
Northern Tuamotu Archipelago 16
  Rangiroa 16
  Manihi Atoll 18
  Takaroa Atoll 18
Marquesas Islands 19
American Samoa 20
  Tutuila 20
Resumé 20

Figures (following p. 23)

1 Route of the "Westward" in Southeastern Oceania
2 Anuanuraro Atoll, Tuamotu Archipelago
3 Gambier Islands, French Polynesia
4 Mangareva Island
5 The islands of Oeno, Henderson, and Ducie
6 Pitcairn Island
7 The island of Rapa
8 Raivavae, Austral Islands
9 Aitutaki Island and Manuae (Hervey Islands) Cook Islands
10 Rarotonga, Cook Islands
11 Bora Bora, Society Islands
12 Huahine, Society Islands
13 Tahiti, Society Islands

Plates

Plate I, figure A.	*Acanthaster planci* upon Acroporan coral after feeding. Freshly eaten area on left. Mangareva Island, Station 3, depth 1½ m, Dec. 12, 1970. Photo by D.M. Devaney.
Plate I, figure B.	Acroporan coral showing fresh feeding scar (upper left), previously eaten, algal covered area (lower right), and living part (center left). Mangareva Island, Station 3, depth 2 m, Dec. 12, 1970. Photo by D.M. Devaney.
Plate II, figure A.	*Acanthaster planci* on underside of recently eaten Acroporan coral. Mangareva Island, Station 3, depth 2 m, Dec. 12, 1970. Photo by D.M. Devaney.
Plate II, figure B.	*Acanthaster planci* among branches of Acroporan coral. Older dead algal covered portions (right) and live coral (foreground, left). Mangareva Island, Station 3, depth 3 m, Dec. 12, 1970. Photo by D.M. Devaney.
Plate III, figure A.	Fresh feeding scar on *Porites* coral and surrounding dead branching corals. Rarotonga, Cook Islands, depth 30 m, Mar. 11, 1971. Photo by D.M. Devaney.

INVESTIGATIONS OF ACANTHASTER PLANCI IN SOUTHEASTERN POLYNESIA DURING 1970-1971

by Dennis M. Devaney[1] and John E. Randall[1]

INTRODUCTION

In recent years considerable interest has been aroused by the damage to reefs in the tropical Pacific caused by large populations of the crown-of-thorns starfish (Acanthaster planci), a coral predator. Survey teams have made starfish counts and assessed the damage to reefs at a number of islands. Most of this activity has taken place in the western Pacific, particularly the Trust Territory and Great Barrier Reef. Very little information has been obtained on the relative abundance of this starfish and the condition of the coral reefs in southeast Oceania.

The opportunity to visit a number of islands in this remote part of the Pacific was provided by a marine biological expedition carried out during the period December 1, 1970 to May 20, 1971 on the 99-foot schooner "Westward" owned and operated at that time by the Oceanic Foundation. During the expedition, Bishop Museum marine biologists Dennis M. Devaney and John E. Randall conducted a reconnaissance for the crown-of-thorns starfish at the various islands visited. When the starfish were present in numbers, an assessment was made of their damage to the coral reefs. At several places, measurements, gonad samples, and color notes were taken of A. planci (Table 1).

The expedition was financed by a grant to the Bishop Museum from the National Geographic Society, augmented by funds from the Oceanic Foundation for operation of the vessel. Support for the surveys of A. planci was provided by the Sea Grant Program of the University of Hawaii.

Surveys for the starfish were carried out at the following groups of islands (number of islands visited within groups shown in parentheses): Tuamotu Archipelago (4), Gambier Group (4), Pitcairn Group (4), Rapa (2), Austral (3), southern Cook (3), Society (3), and the Marquesas (6). In addition, Devaney visited two islands in American Samoa. The itinerary of the "Westward" is shown in Figure 1. Names of the islands visited are underlined.

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(Manuscript received September, 1972--Ed.)

Text figures in this report of the islands at which surveys for Acanthaster planci were carried out are based on maps in Pacific Islands Volume II, Eastern Pacific, 1943, Geographical Handbook Series, Naval Intelligence Division, Cambridge.

DUKE OF GLOUCESTER GROUP, TUAMOTU ARCHIPELAGO

1. Anuanuraro Atoll

On December 6, 1970 the "Westward" anchored off the northwest side of Anuanuraro (20° 25' S; 143° 33' W), a small uninhabited atoll which lacks a pass (Fig. 2). A boat was carried from the seaward side, across the reef flat to the lagoon. A search for Acanthaster was carried out in the western lagoon (Fig. 2, A) with SCUBA and by skin diving. Considerable live coral was present along the sides and top of coral knolls as well as in isolated patches on the sandy lagoon bottom (maximum depth, 40 feet). At one knoll, extending from a depth of approximately 30 feet to near the surface, a large Acanthaster was collected in mid-afternoon along the side of the knoll at a depth of 20 feet. Color notes taken at the time of capture revealed the starfish to have the aboral side greyish to tan with the spines reddish. No recent feeding scars were seen, and the animal was not feeding when taken. Further survey of the knoll and adjacent knolls failed to reveal additional Acanthaster. Measurement data concerning this specimen are presented in Table 1.

Two SCUBA dives were made by Randall and the "Westward" crew off the seaward side of the reef along the northwestern side of the atoll. The first dive (Fig. 2, B) revealed a rather steep slope with live coral and coral rubble; no Acanthaster was seen nor was there any sign of feeding by starfish. The second dive, (Fig. 2, C) which was made farther south, revealed even richer coral growth and more varied topography with caves, etc.; again, there was no sign of Acanthaster nor evidence of coral predation.

GAMBIER OR MANGAREVA GROUP, TUAMOTU ARCHIPELAGO

On December 9, "Westward" anchored at Port Rikitea on Mangareva (Figs. 3 and 4), the principal settlement of the Gambier Group. On December 11 our survey for Acanthaster commenced. Observers included Devaney, Randall, Dean B. Cannoy, and Jean-Pierre Bablet, fishery biologist with Centre d'Expérimentations du Pacifique (C.E.P.). Prior to our arrival we had been informed by personnel of Service de la Pêche and the Institut de Recherches Médicales in Papeete that numerous A. planci had been found along the southwestern side of Mangareva Island (apparently first noted in October, 1969).

Our first station (1 of Fig. 3) was carried out in the lagoon a few hundred yards southeast of Ile Tenoko (23° 4' 30" S; 135° 2' W). Patch reefs were investigated with the use of SCUBA and by skin diving. The majority of the coral was alive; there was no evidence of Acanthaster.

On the afternoon of the same day the second station (2 of Fig. 3) was run outside the barrier reef just southwest of Ile Tenoko at a depth of 20 to 60 feet. Some towing was carried out in the vicinity. Coral growth was lush. No starfishes were seen.

On December 12 a series of seven tows were made (alternating observers) along the southwest shore of Mangareva Island. These constituted Station 3. The first two began at Atituiti and the last ended three miles beyond near the western end of the island. No Acanthaster were sighted until the end of the fifth tow when several were seen. Two specimens were collected, as were the corals (Acropora) on which they were feeding. With the sixth tow the numbers of starfish increased, and the coral damage as well. We had found the A. planci concentration that had been reported to us (X of Figs. 3 and 4). It is a relatively restricted area centered on 23° 7' 20" S; 135° 0' 30" W between Pte. de Ganoa and Pte. Terimuroa at an average depth of 20 feet. Two divers collected 23 starfish in 95 minutes. While towing in the area of greatest density, about one starfish was seen per minute. This certainly does not qualify as an infestation, but this number of starfish is well above the normal occurrence. The coral growth in this area is rich; it is dominated by table and branching Acropora. Estimates of the percentage of live coral by the observers ranged from 65 to 80% (most of the dead coral appeared to have been killed recently, probably by A. planci). About half of the starfish were actively feeding during this time (1300-1435 hours), mainly on species of Acropora. Samples of the coral being eaten were saved. The dominant table acroporan was identified as A. reticulata (Brook) by Dr John W. Wells at Cornell University. Measurements and determinations of sex were made of the sample of A. planci (Table 1). The starfish were bluish-grey aborally, the tips of the spines orange-red.

During the seventh tow the numbers of starfish diminished (eight counted in 13 minutes). By the time Pte. Terimuroa was reached, no more A. planci or white feeding scars on the coral were seen.

On the following day at 1500-1600 hours we returned to the site of concentration mainly for underwater photography (Plates I-II). A strong current (about 2 knots) was flowing in a SE direction, against the prevailing wind.

On December 14 Devaney and Cannoy investigated the lagoon area by towing between Ile Taravai and Ile Agakauitai (4 of Fig. 3). Live coral was found throughout the area but no Acanthaster was noted.

In a conference with Dr Raymond Bagnis of the Institut de Recherches Médicales on March 20, 1971 we learned that surveys for starfish were made in 1969 along the lagoon off Ile Totegegie where the airstrip has been completed and off Ile Kamaka. No significant numbers of Acanthaster were seen.

PITCAIRN GROUP

1. Oeno Atoll

On December 18-20, 1970 "Westward" anchored off the north shore of the uninhabited atoll of Oeno (23° 55' S; 130° 45' W) (Fig. 5). Two days of intensive snorkeling, diving, and some towing failed to reveal any Acanthaster or any sign of recent coral damage that might be attributed to it. The lagoon is shallow (nearly all less than 10 feet deep) and dominated by sand and coral rubble. The occasional patches of coral rock did not have a heavy cover of live coral. The only area outside the reef which was explored was in the vicinity of the small boat passage on the north shore (this passage, by the way, is shallow and would not be safe with even a moderate swell running from the north). Although there were more reef areas outside the reef than in the lagoon, the bottom was still dominated by sand--even to the outer edge of the shelf at 100 feet or more where the slope of the bottom steepened. Dives on outer reef areas were made to depths of 120 feet. Coral growth was richer than in the lagoon, but still sparse by usual atoll standards.

2. Pitcairn Island

A total of 23 days were spent diving and towing around Pitcairn Island (25° 04' S; 130° 06' W) during the period December 21, 1970 to January 21, 1971. This rugged high island is only about 2 miles long and 1 mile wide; consequently, it was not difficult to explore its marine environment thoroughly in the time available. Inshore, the bottom is dominated by boulders, often of large size, heavily carpeted with brown algae (particularly Sargassum). Very little live coral may be found in this zone. In the deeper sectors (below about 40 feet), sand or low-profile rock, either covered with brown algae or a thin veneer of sand, account for most of the bottom. With the help of Pitcairn fishermen the few well developed reef areas were located. These were found mainly at depths greater than 80 feet. The most luxuriant patch reef, known to the islanders as "The Bear", occurs off Gannet Ridge on the north side of the island. It is about 400 square meters in area and rises from a sand bottom with a little rubble in 145 feet to a height of about 30 feet above the base level. It is almost completely live coral. A more extensive reef (about 100 meters in length and about 1/3 this in average width) may be found off Adamstown on the north side in 70 to 100 feet of water. In contrast, this reef is composed of dead coral rock about half covered with colonies of live coral (usually no more than 18" in diameter and mostly *Porites*). In six dives on this reef, (X in Fig. 6) two adult *Acanthaster* were found at 90 feet one of which was preserved and data taken (Table 1). The bottom temperature when one starfish was collected was 24.8° C. Later the same area was subject to a thermocline effect. The water at 90 to 100 feet was roily and at least 2 to 3 degrees C cooler (no thermometer was on hand at this time and when one was brought the following day, the water no longer felt as cool at the 100-foot depth). Very little coral damage was apparent on the reef off Adamstown. One of the two starfish had been feeding, and a sample of the coral on which it fed was taken. No other *Acanthaster* was seen at Pitcairn.

3. Henderson Island

On January 11 and January 17-18 a total of two days were spent on the north and west side of Henderson Island (24° 20' S; 128° 20' W) (Fig. 5). The island is elevated coral limestone, with cliffs along most shores 50 feet or more in height, the central region of the island being at most 100 feet high and relatively flat. Henderson is 5 miles long and nearly 3 miles wide. It is uninhabited except during rare visits by Pitcairn islanders seeking miro wood (*Thespesia populnea*). The shelf region offshore is relatively narrow, but the reefs are more extensive than those of either Oeno or Pitcairn. Dives were made to depths of 160 feet. No *Acanthaster* was seen nor was any damage noted to the coral which might be attributed to this asteroid.

4. Ducie Atoll

For a period of 2-1/2 days beginning January 13, 1971 a marine biological survey was made of Ducie (24° 40' S; 124° 47' W), the easternmost atoll of Oceania. It is small (1.3 miles in greatest diameter) and uninhabited. It is certainly one of the least visited islands of the globe. There is a shallow channel on the SW side to the lagoon which can be negotiated by a ship's boat, except during low tide, providing one is alert for the numerous small coral heads. This small channel is the main exchange for the lagoon, although some water passes over at high tide between two islets on the east side. The deeper part of the lagoon is about 50 feet in depth (53 feet at deepest sounding). The lagoon is interlaced with irregular coral heads, many interconnected at their bases, and many reaching nearly to the surface. The coral on these coral heads is nearly all completely dead. The water of the lagoon had a dark greenish cast, and the visibility was only about

75 feet at the maximum, probably reflecting a low level of flushing. Eight hours were spent in towing, snorkeling, and diving in criss-cross pattern throughout the lagoon. Only one adult Acanthaster was seen, on the SW side of the lagoon just north of the small boat passage, in about 10 feet (Fig. 5, X). This was preserved in formalin (Table 1 for data). Temperature in the lagoon at the bottom and surface was 26.5° C and the salinity 38 o/oo.

In contrast to the lagoon, a moderate amount of live coral was seen in the small boat passage--nearly all as small colonies.

Outside the reef from the small boat passage to the NW corner of the atoll, from the reef edge to at least 100 feet, the bottom was predominantly dead coral encrusted with coralline red algae. It was evident that all of this coral had been killed at approximately the same time. Without a knowledge of the succession of benthic life on dead coral, it is difficult to guess how long the coral had been dead, but it would seem to be at least a year. The nullipores had nearly bridged the gap between adjacent terminal branches of some heads of closely branched Acropora. No Acanthaster was seen outside the reef (dives were made to 180 feet). Time did not permit investigation of the northern or eastern sides of the atoll, but the almost complete disolation of corals in the areas examined did not suggest that the picture would be different elsewhere. Concomitant with the paucity of corals was the dearth of fishes, both in number and individuals; this was all the more evident in view of the total lack of fishing pressure.

In view of the level of devastation of coral by Acanthaster in certain areas such as Guam and the Great Barrier Reef, it would seem plausible that the starfish could be responsible for Ducie's mass mortality of corals. The lack of starfish could be explained by their mortality following decimation of the food supply. Possibly there is some other reason, such as mortality due to intrusion of cold water from more southern latitudes. At almost 25° S, Ducie is near the southern limit of distribution of reef corals. However, reconnaissance at Rapa and Ilots de Bass (see below) even farther south, revealed a proliferation of coral, including acroporans, without evident thermal destruction.

The presence of Acanthaster planci at Ducie extends the known eastern limit of this species and together with the specimens found at Pitcairn represent new distributional records.

RAPA AND ILOTS DE BASS

A period of 25 days between January 26 and February 21, 1971 was spent at the island of Rapa (27° 35' S; 144° 20' W) (Fig. 7) during which time a number of diving stations were worked all around the island. Several sea surface temperatures were taken; they ranged from 23.5 to 25° C. On no occasion was Acanthaster found nor was there any indication of coral predation by the starfish. Although the local residents were familiar with the crown-of-thorns (known throughout the French Polynesian area as Taramea) via radio descriptions from Tahiti and most recognized this starfish from our photographs, all denied its existence in their waters.

Around most of Rapa coral growth is poor, at least in depths less than about 50 feet. There are, however, well developed fringing reefs in Haurei (Ahurei) Bay and luxuriant patch reefs off the entrance to the bay. Table and branched acroporan as well as many other scleractinian corals were noted and collected. For the most part, the corals are vigorously growing and well developed in this area.

On February 20 a visit of one day was made to Ilots de Bass (Marotiri) (27° 57' S; 143° 26' W), about 50 miles SE of Rapa. Short survey dives were made between NE and SE Rocks in depths from 0 to 150 feet. The deeper areas showed a bottom covered with lush, vigorously growing acroporan and other corals, interspersed with sandy areas. No Acanthaster was noted.

THE AUSTRAL ISLANDS

Three of the Austral Islands were visited between February 25 and February 28, 1971. At Raivavae (23° 52' S; 147° 40' W) we heard from a school teacher that the crown-of-thorns had been seen within the lagoon on the SW side but not in great numbers. On February 25, together with this man, Devaney, Randall, and two members of the "Westward" crew examined the area where Acanthaster had been noted (Fig. 8, 1). Over an hour's survey in the shallow part of the lagoon failed to reveal any Acanthaster or evidence of coral damage which might be attributed to this starfish. SCUBA diving outside the lagoon beyond Motu Haa (Haha) and off the southern boat passage in depths from 20 to 175 feet revealed considerable live coral but no Acanthaster.

Dives at selected sites around the islands of Tubuai and Rurutu failed to demonstrate any Acanthaster or evidence of coral depredation. At Tubuai, the dives were made within the lagoon near the NW side and off Motu Moturoa by Devaney and out beyond the barrier reef on the north side, west of the boat passage by Randall during the afternoon of February 26. At

Rurutu, diving was conducted off Avera Bay and more extensively off Moerai Bay on the NE side of the island during February 27 and 28. Local residents and officials of the French government at both of these islands had not seen or heard of the crown-of-thorns in their waters.

SOUTHERN COOK ISLANDS

1. Manuae (Hervey)

On March 6, 1971 between noon and 1800 hours, Devaney examined the lagoon and one seaward site of Manuae (Fig. 9, insert) for *Acanthaster*. A small boat was dragged through the shallow channel along the NE side of Manuae Islet (19° 21' S; 158° 58' W). The lagoon was crossed between Manuae and Te Au O Tu Islets. Very little coral appeared in the shallow parts of the lagoon (depths 2-6 feet). Many black sea cucumbers, primarily *Holothuria atra*, were seen on the white sand bottom. Later in the afternoon a dive was made in the deeper portion of the lagoon near the south central part where the bottom depth is 16 feet. Several coral knolls rise very near the surface. The coral was alive and extensive, especially along the upper margins of the knolls. Several underwater photographs were taken of coral along such edges. No evidence of *Acanthaster* nor coral damage from the starfish was noted.

In the late afternoon, on the seaward side of Manuae Islet just SE of the small boat channel (Turakina Passage) (Fig. 9, X), Devaney and Rhett McNair made a SCUBA dive from 40 to 180 feet. The deeper zone from 120 to 180 feet is nearly vertical. The bottom here was dominated by large sheetlike terraced colonies of live *Porites*. Very few other live corals were present, but there was considerable dead coral covered with coralline algae. Leading into this steep sector is a canyon which appears to be an erosion channel. This was examined from a depth of 40 to 100 feet. The bottom of the canyon, which averages about 20 feet in width, is clean sand and boulders, some cemented by nullipores. The walls are between 10 and 15 feet in height. Above the walls, on the south side, 80 to 90% of the bottom was covered with dead coral. Most of this coral, especially the branching forms of *Acropora* and *Pocillopora*, was cemented in place by nullipores. In some areas a scum of blue-green algae covered much of the surface. Although there was no sign of *Acanthaster* in this area, the high percentage of dead coral condition of the bottom was reminiscent of the reefs killed by the starfish in Guam. Possibly the dead coral was a result of an infestation of *A. planci*.

2. Aitutaki

Beginning at noon on March 7, 1971 the lagoon of Aitutaki (18° 53' S; 159° 47' W) was surveyed by Devaney, Rich Costello, and James Haywood. The path of the survey is shown by the dotted line of Fig. 9 beginning just south of the main village of Arutanga. Numerous coral knolls (most about 15 to 30 feet in diameter) occur in the zone between A and B Fig. 9. Ten of these knolls were examined completely by two or more divers. Up to 90% or more of the branching corals (mostly Acropora and Pocillopora) were dead. Much of the dead coral was covered with brown, green, and coralline red algae. Soft corals and the blue starfish Linckia laevigata were common (3 to 8 starfish per knoll). Approximately at point B the first coral heads with live branching acroporan corals were noted. The depth to the sand bottom here is 10 to 12 feet. Each of these knolls had several adult Acanthaster on them. Most of the starfish were concealed near the lower part of the knolls (one of six starfish on a knoll was on the sand bottom beneath a ledge). None of the starfish were feeding, but fresh feeding scars were evident on the corals.

Moving toward Maina Islet from point B the knolls had a higher percentage of live coral and fewer A. planci. On these heads with more live coral Linckia laevigata was not common. The direction of survey was then altered toward Tekuotu Point, and random knolls were investigated. The greatest concentration of A. planci was noted on knolls near Tekoutu Point. Here several of the starfish were seen actively feeding on coral along the edges of knolls near the surface. Underwater photographs were taken in this area and starfish were collected from three of the knolls.

Towing over the sandy bottom between knolls there are small heads of Acropora (probably formosa) which were mainly dead, with indication of not having died too recently. Only a few had the usual commensal invertebrates and the pomacentrid fish Dascyllus aruanus associated with them.

Proceeding SSE from Tekoutu point we entered an area so shallow with numerous coral heads (Fig. 9, D) that it was impossible to continue towing. The coral here was alive, and there was no evidence of Acanthaster.

We conclude from this survey that there was an active zone of predation by A. planci in the lagoon of Aitutaki between the wreck of the Alexander and Tekoutu Point (approximately B-C of Fig. 9). We believe that the starfish have advanced in a southerly direction from Arutanga and are responsible for the dead coral. That they have crossed areas of bare sand is suggested by the high percentage of dead stands of Acropora between the knolls. The absence of small or even medium-sized starfish is also indication that a single relatively small population of A. planci has moved as a progressive front in the Aitutaki lagoon.

Mr Val Hinds, the Fisheries Officer of the South Pacific

Commission, made a brief survey for Acanthaster in the lagoon of Aitutaki in the summer of 1970. He failed to find any starfish at that time. Iopa Marsters, a Rarotongan fisherman who accompanied Mr Hinds during his survey, was also with our team at Aitutaki. He does not recall seeing the many knolls of dead coral during the 1970 investigations. He stated, however, that the survey group had little experience with Acanthaster and its damage to corals.

On March 8 between the hours of 0830 and 1105 a survey was made of the seaward side of Aitutaki from Arutanga Passage south to Maina Islet (the dotted line of E-F, Fig. 9), a distance of about 4 miles. An observer was towed behind a small boat and spot checks were made by skin and SCUBA diving. Devaney was assisted in this survey by Haywood and David Bryant of the "Westward" crew.

The seaward shelf of this area, from a depth of 10 to 100 feet, consisted mainly of dead coral. A few encrusting corals were alive as were occasional small heads of Acropora and Pocillopora, and there was live Millepora and soft alcyonarian corals. Approximately 80 to 90% of the scleractinian corals, including massive heads of Porites, were dead. No evidence of Acanthaster was noted. Underwater photos were taken and samples of dead coral taken. The samples revealed much encrustation by coralline red algae (up to 1 mm in thickness). It is very possible that Acanthaster is responsible for the extensive coral mortality of this sector of Aitutaki.

Cook Island government officials informed us that there has been heavy use of chlorinated hydrocarbon insecticides at Aitutaki in recent years. They also mentioned that several 55-gallon drums of DDT had been dumped in or just outside Arutanga Passage after World War II.

3. Rarotonga

When Devaney went on "Westward" to Manuae and Aitutaki, Randall remained at Rarotonga (21° 13' S; 159° 46.5' W) with Dean B. Cannoy for a survey of Acanthaster there. Devaney returned for the investigations on Rarotonga on March 10.

On March 6, 1971 Randall was towed from Avaavaroa Pass on the south side of Rarotonga for a distance of 300 meters to the east over an average depth of 40 feet (Fig. 10, A). Away from the pass the water was clear enough to reveal a bottom nearly completely covered with live coral with no trace of Acanthaster. A dive was then made in 50 feet with SCUBA in the company of Walter Hambuechen, the Agriculture Officer of the Cook Islands. Toward the end of the dive, the deeper portion of the reef was investigated. At about 80 to 90 feet some dead coral was observed. At 100 to 125 feet fresh feeding scars from Acanthaster were seen; the coral here was 90% dead. Two adult *Acanthaster* were observed in this area, one of which was brought to the boat (398 mm in diameter, 1315 gms; see Table 1), along with two kinds of coral on which it was feeding. After a return to shore for fresh tanks, a second dive was made (with Dean B. Cannoy) in an attempt to find the same deep area of heavy coral destruction. The exact area was not located, for no fresh feeding scars and no *Acanthaster* were seen, but the coral was at least 90% dead at 100 feet and below, with some dead coral apparent at the 80- to 90-foot level.

The south shore of Rarotonga is subject to consistent heavy swell. On only a few days of the year is it calm enough to venture through the pass in a small boat for diving as we did on March 6. We believe that the heavy surge may be responsible for *Acanthaster* avoiding coral in the shallower sectors of the southern Rarotongan reef.

On March 7 two dives were made off the oil tanker buoys near the harbor entrance on the north shore of Rarotonga (Fig. 10, B). In one half hour, at a depth of 50 to 80 feet, Randall counted 26 *Acanthaster*. Of these, 18 were feeding, mostly on *Porites*. The bottom in this area is about 3/4 coral, as viewed from above. Of this, 60 to 70% was dead. Most of the surviving coral is *Porites*, some of which stands in large heads 10 to 15 feet above the base level of the bottom. One cannot help but feel that the starfish have avoided *Porites* initially, but now are forced to feed on it in view of the paucity of more favored kinds. Samples were taken of three species of coral on which the starfish were feeding.

The second dive began at the easternmost of the two buoys (depth 45 feet), and moved toward shore to a depth of 30 feet. There was more live coral in this zone, but still about half was dead. In ten minutes no *Acanthaster* were found and no very recent coral damage was seen. However, we believe the older damage was due to the starfish, particularly since it involved mainly species other than *Porites*.

A third dive on March 7 was made off the laundry, 1 kilometer west of the oil tanker buoys (Fig. 10, C). The depth was 45 to 80 feet. In a dive of 30 minutes three adult *Acanthaster* were counted, one of which was feeding on coral (sample taken). This area had more sand bottom than the previous areas (about half sand and rubble, and half coral). Half of the coral at this locality was dead, seemingly from *Acanthaster*. Most of the surviving coral was *Porites*. No towing was possible from this area to the harbor because of turbidity of the water.

An attempt was made on the morning of March 8 to launch the small green fiberglass skiff through an alleged boat passage near Black Rock, NW Rarotonga. This proved impossible and the morning was lost. In the afternoon towing was attempted directly off the wreck of "Yankee" on the reef of Avarua (Fig.

10, D). It was not possible to see the bottom well enough because of dirty water, so a dive was made in 45 to 55 feet. In 30 minutes 38 adult *Acanthaster* were counted. Of these, 18 were feeding, seven on *Porites*. Samples were saved of four coral species other than *Porites* on which the starfish were feeding. In this area the bottom is about 85% coral, about half of which is dead. Again, most of the surviving coral is *Porites*.

The starfish were detached from the bottom to determine whether they were feeding or not. When detached, they fold their arms ventrally, thus forming a nearly complete spinous ball which tends to roll in sand channels with surge. One such detached starfish rolled back with the surge to strike Randall's wrist and one finger and inflict seven deep spine wounds.

A second dive was made on March 8 off Pue, 1.3 kilometers east of the wreck of "Yankee" (Fig. 10, E). The dive covered a depth range of 30 to 100 feet in an area where the bottom was about 50% coral. Coral damage was nearly as heavy as off "Yankee" but only eight *Acanthaster* were sighted in 30 minutes; all but one of these were in the depth range of 80 to 100 feet. Because of disconcerting pain from the spine wounds, Randall was probably not as alert in counting as he would otherwise have been.

That evening the pain was still mainly confined to the wrist and hand, although there was some radiation up the arm. The next morning pain had subsided in the limb but an overall illness prevailed which necessitated bed rest. Among the symptoms were backache, headache, joint pain, malaise, and loss of appetite.

The wounds were slow to heal, particularly three of them around which necrotic tissue developed to a radius of about 3 mm. A week later there was still soreness around these three wounds and severe itching of those more fully healed.

On March 10, 1971 Devaney was towed along the northwest side of Rarotonga between Motu Toa and Black Rock for a period of 10 minutes (Fig. 10, F). During this period 57 *Acanthaster* were sighted over a distance of approximately 500 yards. Individual starfish were scattered over the bottom in depths from 30 to 55 feet. It was noted that in several cases more animals aggregated along edges of coral ridges next to shallow sand grooves. A check dive in this area showed considerable dead branching coral but with the large scattered heads of *Porites* still mainly alive. A few fresh white feeding scars were evident. At the end of the tow the water was becoming turbid, but there was no sign that the number of *Acanthaster* had decreased.

Later in the morning of March 10th, Devaney, Randall, and Hambuechen made a SCUBA dive just south of Black Rock (Fig. 10,

G) at a depth of 90 to 100 feet. Our location was approximately 3/4 mile SW of the end of the earlier tow (Fig. 10, F). We noted that most of the branching Acropora and Pocillopora coral was dead, well covered with low algae and in some cases had a covering of coralline algae. Live heads of Porites remained. No Acanthaster was noted in the small area circumscribed during this dive (approximately 100 yards in diameter).

In the afternoon of the same day a SCUBA dive was made between the two oil line buoys about 200 meters west of Avatiu Harbor at a depth of 40 to 50 feet (Fig. 10, B). Massive live Porites heads with rubble and sand patches dominate the area with smaller less abundant heads of branching corals present. These branching corals, mostly Acropora spp. and Pocillopora spp. were found to be dead and overgrown. No Acanthaster was sighted; however, a dive to the same area two days later resulted in the sighting of three adult starfish, one of which was feeding on Porites.

On March 11, 1971 Devaney, accompanied by Mr Hambuechen, surveyed the north side of Rarotonga, east of Avarua Harbor. Towing commenced west of the wreck of the "Yankee" at a depth of 50 feet and proceeded parallel to the coast for 100 yards; no Acanthaster was evident although the bottom appeared to be dead coral. We turned seaward into deeper water. At a depth of 100 feet we noted the first Acanthaster traveling over sand between coral ridges; immediately thereafter a large number of starfish was observed in a concentrated band about 50 yards wide extending eastward. A SCUBA dive at a depth between 100 and 120 feet was made. We counted 23 adult individuals covering an area about 50 yards in diameter next to a sand groove. Several starfish were feeding on Porites. Only a small percentage of the branching corals were observed to be alive; the rest were covered with low algae and nullipores, the latter filling in the crevices between branches. Underwater photographs were taken with Nikonos and flash. Seven of the smaller Acanthaster were collected for size and sex measurements (see Table 1), and gonad samples taken. A portion of two individuals collected was retained for later examination (one which was yellowish colored with numerous pedicellaria). The color of most of the specimens appeared greenish, greyish, or bluish at 100-foot depth but were red in the flash pictures and red upon bringing the starfishes to the surface, the difference in color being due to the extinction of red color with depth.

In the time available we were unable to survey the entire coastal area of Rarotonga, but the numerous A. planci and extensive coral damage observed at widely separated areas suggests that the starfish might be expected in abundance all around the island.

Rarotonga with about 13,000 people is the most populous of the Cook Islands. Agriculture is important, and the use of chlorinated hydrocarbon insecticides--first DDT and now mainly dieldrin and lindane--is excessive (Hambuechen, personal communication).

SOCIETY ISLANDS

1. Bora Bora

On March 18, 1971 two teams of divers examined the coral and bottom environment on both sides of Teavanui Pass on the west side of Bora Bora (16° 30' S; 151° 45' W) (Fig. 11). One team (Devaney, McNair and Bryant) worked along the northern rim of the pass and seaward as far as the northern end of Ile Teveiroa. With the exception of a small area off the middle of Ile Teveiroa which revealed dead coral, the pass and seaward region appears to support considerable live coral. No Acanthaster was observed. The one small area with dead coral shows a westward projection of the reef and appears to receive heavy surf. The dead coral probably resulted from wave action. At a depth of 40 feet, and deeper off this area, live coral was abundant.

The second team of divers (Randall and Cannoy) was towed along the south side of the Teavanui Pass and south as far as the middle of Ile Tupua (Toopua) about 1.2 miles from the pass on the seaward side. No signs of coral damage due to the crown-of-thorns could be detected. The bottom was mostly live coral. A few heads of Acropora with white areas were noted, but diving failed to reveal any starfish.

A SCUBA dive including both Devaney and Randall on the seaward side outside the reef (Fig. 11, X) showed a moderately steep drop from 60 to 155 feet. A considerable amount of live coral was seen on this slope. The bottom was mainly sand between 155 and 175 feet. There was no evidence of Acanthaster activity.

According to an informant in Bora Bora, Erwin Christian, who operates a glass-bottom boat and has a SCUBA facility, there has been no evidence of an increase in the number of Acanthaster at this island. Only an occasional individual is sighted. He mentioned having recently seen one or two in the southwestern part of the lagoon south of Ile Tupuaiti. We towed an observer in this sector of the lagoon during the afternoon of March 18 but failed to find any A. planci or coral damage.

2. Huahine

On March 19, 1971 several hours were spent along the northwest side of Huahine (16° 45' S; 151° W).

A tow was made from inside Avamoa Pass to Avapeihi Pass along the seaward side (Fig. 12, A). There were no signs of

Acanthaster; the mouth of the Avamoa Pass on the south side is a scoured pavement bottom with isolated heads of live *Porites* and *Pocillopora* coral. Along the seaward side between the two passes, the bottom is also hard with a few shallow sand grooves and pockets. It is mostly covered with live coral, including *Pocillopora eydouxi*, *P. meandrina* and *Acropora spp*.

A second tow was made on the seaward side south of Avapeihi Pass for a distance of 200 yards to a point just opposite Mt. Tavahi (Fig. 12, B). Some dead coral and rubble was noted and a SCUBA dive by Rhett McNair off a steep slope to 80 feet revealed a considerable amount of dead coral; however, no *Acanthaster* was observed nor were there any fresh feeding scars.

SCUBA dives were made north of Avamoa Pass (Fig. 12, C). Live coral banks separated by shallow rubble and sand grooves were noted in depths from 20 to 100 feet. There was no sign of *Acanthaster*.

Several persons familiar with the waters of Huahine, both at the island and in Tahiti, informed us that they knew of no indication of an abundance of *A. planci* there.

3. Tahiti

As early as May 1969, evidence of *Acanthaster* predation on Tahitian coral reefs was known. By October 1969 the Service de la Pêche in Papeete with volunteer help began a control program in the lagoon areas at Punaauia and Paea, 17 and 21 kilometers SW of Papeete, respectively. A resume of the control program through October 1970 is available in a 9-page mimeographed report of the Service de la Pêche, dated December 1970.

Through the kindness of Dr Raymond Bagnis of the Institut de Recherches Médicales at Papeete and Dr S. Stein, Chef du Service de la Pêche, we were able to examine several of the most affected areas, especially Punaauia and Faone.

On March 22, 1971 the lagoon of the district of Punaauia was visited (Fig. 13, A). The devastating effect on the lagoon corals, particularly near the barrier reef, was noted. Over 10,000 *A. planci* had been removed from this sector. We were able to find only 12 adult specimens in a period of three hours. A special effort was made to find juvenile starfish, but none were seen. A few small white feeding scars were observed near basal portions of staghorn *Acropora*, but diligent searching for young *A. planci* in the vicinity of these scars failed to yield any specimens. Our smallest specimen from the area was of medium size (1100 grams).

On March 23, 1971 Devaney joined Mr Francis Nanai from the Institute de Recherches Médicales and Mr Phillip Tsu and three other divers from the Service de la Pêche for a starfish control mission in the lagoon of Faone on the eastern side of Tahiti (40 kilometres from Papeete). We were informed by Tsu that as recently as March 9, 1971 several hundred Acanthaster had been removed from this area. Four divers of our group collected 40 specimens of A. planci in about two hours. The starfish were thrown into a small boat, taken to shore, and placed on land for 48 hours before being dumped. No chemical injection or other methods of eradication have been employed in Tahiti.

On the outside of the fringing reef an examination was made of the bottom parallel to the reef edge along a transect of 200 yards. Dives were made from the reef edge to depths of 50 feet at a distance of about 100 yards from the reef edge. There is a heavy cementation of the coral and rubble with coralline algae. This often obliterates the branches of the corals, making it difficult to determine the amount of previous live coral cover. There is partial coral recolonization over the cemented substratum at Faone. No small A. planci were found, in spite of careful search.

On March 28 and 29 SCUBA dives were made by Randall and Cannoy on the outer reef outside Papeete Harbor off the middle of the concrete breakwater in the vicinity of a wreck of a large iron-hulled sailing vessel. Depths ranged from 20 to 250 feet. The coral growth was good. A few whitish patches on the coral suggestive of Acanthaster damage were seen in the depth range of 60 to 100 feet, but no starfish could be found. The water was too turbid for towing; also there was an oil slick on the surface.

On March 29, the sea was moderately clear NE from the end of the breakwater, and it was possible to see the bottom in 30 to 40 feet. A tow was made for 1.5 miles over this depth from the NE end of the breakwater toward Tau-noa Pass. The bottom was dominated by small heads of Pocillopora meandrina. No Acanthaster were seen.

It is perhaps no coincidence that Tahiti and Rarotonga, the only islands of heavy infestations of Acanthaster planci of the 27 we visited in SE Oceania, are the ones of the greatest human habitation and heaviest agriculture. One of us has already suggested that there may be a connection between the use of chemical pesticides and the outbreaks of the crown-of-thorns starfish (Randall, Biotropica, 4, 1972, 132-144).

NORTHERN TUAMOTU ARCHIPELAGO

1. Rangiroa

Rangiroa is the largest atoll in the Tuamotus. Its eastern end lies at 15° 17' S; 143° 13' W. There are two passes, both on the north side, about 5 miles apart. In 1957 there were 700 inhabitants, mostly in two villages, one at the eastern side of each pass.

On April 6, a dive was made from 40 to 100 feet on the outer reef 200 yards east of Tiputa Pass, the easternmost of the two passes. The coral growth was extremely rich. No Acanthaster were seen, nor was any damage to the coral suggestive of the starfish noted.

On April 7 and 8, dives from 20 to 60 feet were made on groups of coral heads in the lagoon of Rangiroa about 1 mile east of Avatoru Pass. Less than 50% of the hard bottom consisted of live coral. There was no sign of Acanthaster.

On April 8, a tow was made from the western side of the pass 1/2 mile to the west, the tow commencing at the outer half of the pass. At the edge of the pass in 15 to 40 feet there was considerable dead and broken coral, but not suggestive of Acanthaster damage. On the outer reef in the region of the tow (30 to 40 feet) the bottom was monotonously flat coral rock studded with small heads of Pocillopora, Porites, and Millepora (coral about 1/3 of bottom area). The water was somewhat turbid by atoll standards (evidently the discharge from the pass moves mainly westward). At the outer edge of the reef the slope steepens and the coral growth is richer. No Acanthaster were seen.

A tow was then made from the outer part of the pass on the eastern side for one mile in the easterly direction, at an average depth of 50 feet. Because the water was very clear, it was possible to see over a depth range of at least 20 to 80 feet. Except at the outer part of the pass and the first 200 yards or so to the west, which was flat coral rock bottom with scattered small heads of coral, the bottom was almost totally covered with coral in the 20 to 80 foot depth range. A dive was made to 150 feet at the end of the tow. The following day sporadic brief tows were made from one mile to slightly more than two miles to the east of the pass, with no change in bottom type. Two dives were made from a range in depth of 15 to 140 feet. There is a steep drop-off of 60 to 70 degrees with sand, coral rock, and some live coral beginning at about 70 to 80 feet. Only a very few small white dead areas on coral were noted, and no Acanthaster were seen. The dominant coral is Pocillopora. In several broad areas in the depth range of about 30 to 70 feet in the vicinity of one to two miles east of Avarua Pass, about one third of the Pocillopora is dead and very heavily encrusted with coralline algae and other marine growth. If such damage were caused by Acanthaster in abundance, one can only wonder why no starfish could be found at this time in the area of partially dead coral.

In the afternoon interviews were made with local divers with the help of Dr Pierre Fourmanoir, ichthyologist of O.R. S.T.O.M., New Caledonia, who was visiting Rangiroa at the time. One man recalled finding seven *Acanthaster* about six months ago on the east side of the pass between the concrete dock and outer reef. A tow was made over this area the next day (day of departure). As on the other side of the pass, there was considerable dead coral but very little of recent origin. Most was *Pocillopora*. Very little *Acropora* was seen, dead or alive, and this in deeper sections. Moderate heads of *Porites* are common. A few small patches of white on the coral were visible. One adult *Acanthaster* was seen.

2. Manihi Atoll

The atoll of Manihi (western extremity 14° 27' N; 146° 05' W) has a single passage, Tairapa Pass, to its lagoon on the SW side. A village (200 inhabitants in 1948) lies on the SE side of the pass. The lagoon is shallow, the NW end of the pass with soundings of as little as 1.2 to 2.2 meters across it. The pass is only 246 feet wide and the dock has less than 10 feet of water. With no suitable anchorage, "Westward" stayed at Manihi only during the daylight hours of April 11.

Tows were made in the outer half of the pass in either direction for about 1/4 mile. The water was very clear, and the coral growth was rich and diverse in both directions from the pass (at the edges of the pass *Pocillopora* dominated). The outer reef is narrow, so it was possible to see the bottom from the shore to the drop-off in about 60 to 70 feet. No *Acanthaster* were observed. Only a few white patches were observed on the coral; these were mainly on *Acropora* and appeared to be the result of feeding by fishes.

Dives were made to 100 feet 1/4 mile NW of the pass and to 180 feet SE of the pass for selective fish collecting. No starfish were observed at this time.

Late in the day before departure an interview was held with about 20 adults of the village on the incidence of *Acanthaster*. They reported that a moderate number could be found at places in the lagoon. When asked how many one diver might count in two hours of swimming, the reply (after some hesitation and comparing of opinions) was 10 to 12. Unfortunately there was then no opportunity to make any reconnaissance of the lagoon.

3. Takaroa Atoll

Takaroa is one of two atolls of the King George group (the other, Takapoto lies 5 miles SW). The SW extremity is located at 14° 31' S; 145° 4' W. The atoll is about 15 miles long and 5 miles wide. There is a single pass, Teavaroa, on the SW side.

The village of Teavaroa, with about 140 inhabitants today, is on the north side of the pass. Takaroa is one of the more valuable atolls with respect to its resource of blacklip pearl oysters. The taking of pearl shell was forbidden during our stay at the atoll. In fact, it was necessary to obtain permission to dive in the lagoon.

Interviews were carried out with several natives who were divers. All stated that the "taramea" (Acanthaster) is very rare at Takaroa, both in the lagoon and outer reef (though they would know the lagoon better, for toxic fishes are known to occur outside the reef whereas the lagoon fishes are reportedly safe; thus fishing, plus pearl diving, takes place principally in the lagoon).

The pass and lagoon were very turbid while "Westward" was at Takaroa. Towing for Acanthaster was carried out only on outer reef areas.

On April 12 a tow was made over an average depth of 40 feet for a distance slightly greater than two miles south from the pass. A near-vertical discontinuity of perhaps 10 feet was apparent along much of the outer reef a short distance from the reef front where the surf was breaking. Seaward of this there was often a depression of a few feet. Then a broad outer coralliferous terrace to a drop-off in about 60 to 70 feet. Coral growth was rich and diverse on this terrace. No starfish or starfish damage were noted.

On the following day a tow of about two miles was made in the northern direction. The bottom was similar to that south of the pass, but about a mile to the north it was noted that an increasing amount of the bottom was covered with light pink coralline algae. A dive was made from near shore to 220 feet. From one third to one half of the bottom consisted of long-dead coral overgrown with coralline algae, new coral, and Millepora (but primarily coralline algae). The existing live coral is mainly in small heads. On the outer part of the reef at this area in 40 to 50 feet, the coral growth was better and by the edge of the drop-off, the bottom was almost completely coral-covered. Most of the coral in the 15 to 40 foot zone, both live and dead, is Pocillopora. No Acanthaster were seen.

On the morning of the 14th, the day of departure, a dive was made on the north side of the pass from the dock to the entrance. A few white patches were found on Pocillopora, but no starfish could be found.

MARQUESAS ISLANDS

The period between April 18 and May 19, 1971 was spent visiting the six principal Marquesas Islands. All six islands were examined for the presence of Acanthaster or effects of its predation on the coral fauna. There was no indication of the starfish nor any damage to coral which could be attributed to it.

Two persons in Tahiti had mentioned that the "taramea" was known from the Marquesas, but we still have no verification of the species there.

AMERICAN SAMOA

1. Tutuila

Devaney arrived at Tutuila (14° 20' S; 170° 40' W) on March 25, 1971 and spent three days on the island and the small adjoining island of Aunuu. During this period a conference with the Governor, John Haydon, was arranged. He expressed his concern about the possibility of Acanthaster infestation but stated that there was no evidence of a population increase at that time.

Two areas along the southwest coast of Tutuila, Coconut Point and Fagatogo, were examined for signs of Acanthaster. A dive was also made along the west side of Aunuu Island. No crown-of-thorns were seen. At Coconut Point the cushion starfish (Culcita) was observed feeding selectively on small heads of Pocillopora damicornis.

Resumé

1. A small population of Acanthaster occurs off the southwestern side of Mangareva Island in the Gambier Group. Little coral damage was noted and the population has apparently remained relatively stationary for at least 2 years.

2. The distribution of Acanthaster planci is extended as far east as Ducie Atoll (Long. 124° 47' W) and new records for the species are from Ducie, Pitcairn, and Anuanuraro Atoll.

3. Ducie Atoll appeared to have a considerable amount of dead coral. A paucity of marine life is attributed to geographic position and possibly isothermic conditions. The cause of the dead coral was not determined.

4. Acanthaster apparently has not reached Rapa and only one island in the Austral group (Raivavae) was reported second-hand to have had "taramea" (Acanthaster). Rapa and the Australs support a fairly rich coral fauna including acroporan corals.

5. In the southern Cook Islands, coral depredation due to Acanthaster was evident at Aitutaki in a portion of the lagoon.

The presence of up to 90% of dead scleractinian coral along a 4 mile seaward stretch of Aitutaki suggests Acanthaster activity in the past. Little recruitment of new coral was noted and coralline algae cementation was conspicuous. A single dive on the seaward side of Manuae revealed a similar condition but further work there is required to verify the cause(s). Rarotonga shows a considerable concentration of Acanthaster, and coral predation is extensive, especially to the east and west of Avatiu and Avarua Harbours. Additional Acanthaster and dead coral was noted near Avaavaroa Passage off the south side in depths from 100 to 125 feet.

6. In the Society lslands, only Tahiti has large concentrations mainly affecting the lagoon areas. Since 1969, and continuing presently, a control program has been underway by the Service de la Pêche.

7. In the Northern Tuamotus only one atoll, Rangiroa, was reported second-hand to have had a small concentration of the "taramea". The survey found only a single specimen of the starfish and no appreciable coral death which could be attributed to A. planci.

8. In the Marquesas Islands, no Acanthaster was found and only second-hand reports which could not be verified suggested that this starfish occurs in these islands. There is a definite reduction in the number of coral species, especially acroporan types, in these islands.

9. In American Samoa, although Acantnaster is known around the main Island of Tutuila, discussions with the Governor indicate that there has not been extensive Acanthaster predation nor have any large concentrations been noted.

TABLE 1. ACANTHASTER DATA REPORT SHEET - SOUTHEASTERN POLYNESIA

LOCALITY	SEX	GONAD COND.*	WT. (gms)	DIAM. (cms)	DISC DIAM	NO. ARMS	REG.**
Anuanuraro Atoll Dec. 5, 1970	F	R	2825	46	21	16	0
Mangareva Dec. 10, 1970	F	R	1975	48	22	17	1
	M	R	1675	41	24	17	0
	F	R	2035	39	24	17	0
	F	U	1450	35	19	16	1
	F	U	1650	37	18	16	0
	M	R	1775	46	24	17	0
	F	R	1885	40	25	21	1
	F	U	1675	37	20	19	0
	M	U	1475	40	20	17	0
	F	R	1350	38	21	19	0
	M	R	1275	36	18	17	0
	F	U	1475	40	23	17	0
	F	R	1625	36	20	21	5
	F	U	1635	40	22	20	0
	M	R	1400	36	19	17	0
	M	R	2025	40	19	19	0
	F	R	1500	40	19	17	0
	M	R	1625	39	21	16	0
	M	R	1275	36	18	17	0
	M	U	1875	45	21	18	2
	F	U	1035	35	15	15	0
	M	R	2000	40	23	19	3
	F	S	1655	38	21	17	0
	F	U	1775	43	22	17	0
	M	R	1025	30	19	18	0
Pitcairn Island Jan. 8, 1971	M	R	1800	40	24	18	4

Ducie Island (Atoll)							
Jan. 13, 1971	M	?	2250	45	25	18	1
Aitutaki							
Mar. 7, 1971	M	R	1900	37	21	17	1
	M	R	1100	32	18	18	0
	M	R	2000	41	22	17	0
	M	R	2050	43	21	15	0
	M	R	1100	33	16	15	1
	M	R	1775	40	18	15	0
	F	R	2200	38	18	17	3
	M	R	1600	33	15	17	1
	F	R	2260	37	18	18	0
	M	R	1500	35	18	17	0
Rarotonga							
Mar. 6, 1971			1315	39.8			
Mar. 11, 1971			1525	40	17	16	0
			1525	41	18	17	1
			1425	41	19	16	2
			1650	42	20	16	1
			1225	38	19	16	2
			1575	41	19	16	2
			1050	36	17	16	1

*Gonad Condition: U-unripe, R-ripe, S-spent

**Number of arms regenerating

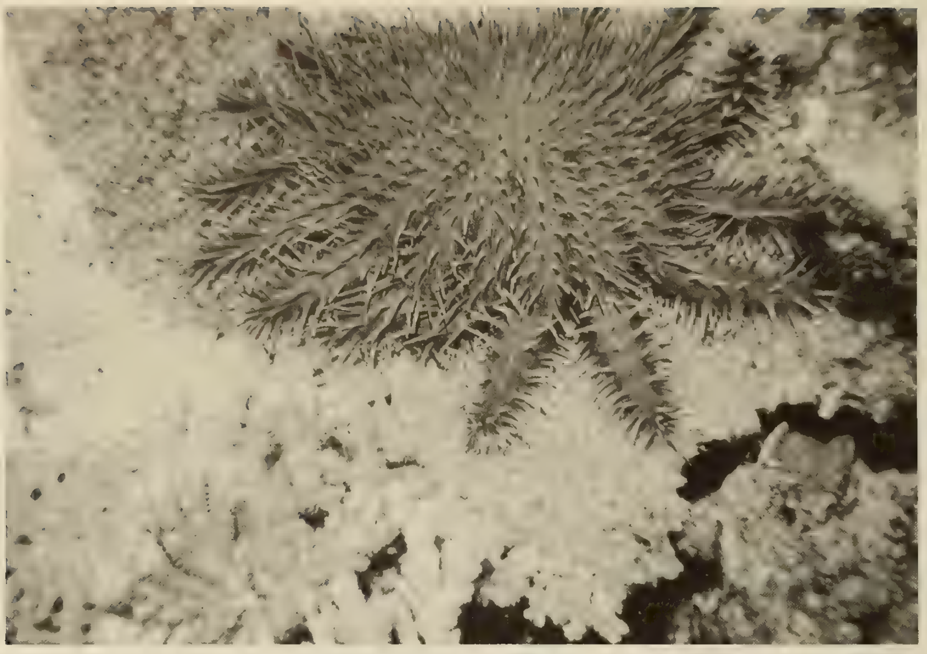
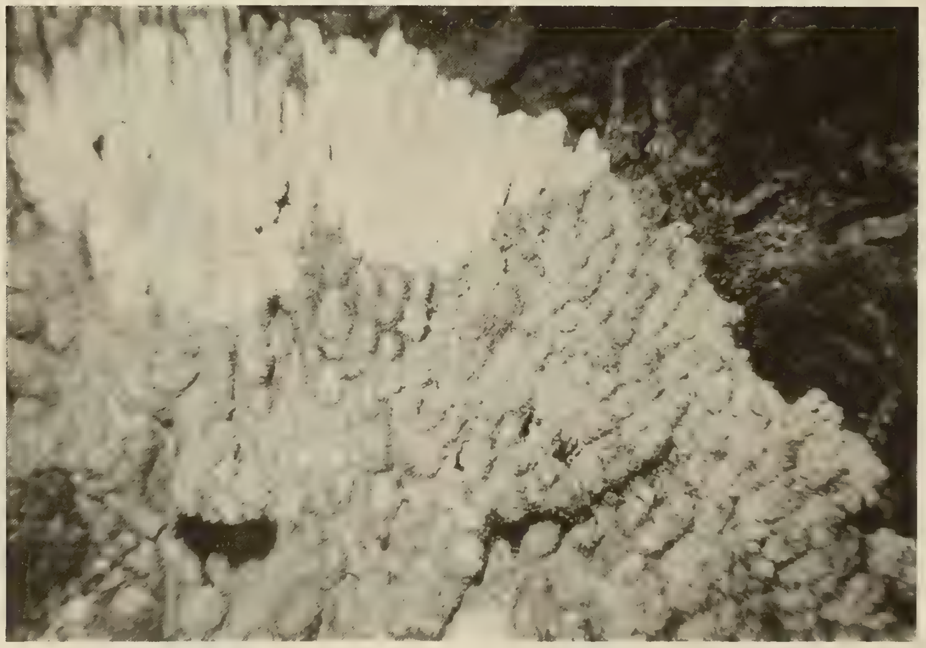


Plate I, figure A. Acanthaster planci upon Acroporan coral after feeding. Freshly eaten area on left. Mangareva Island, Station 3, depth 1½ m. Dec. 12, 1970. Photo by D.M. Devaney.

Plate I, figure B. Acroporan coral showing fresh feeding scar (upper left), previously eaten, algal covered area (lower right), and living part (center left). Mangareva Island, Station 3, depth 2 m, Dec. 12, 1970. Photo by D.M. Devaney.



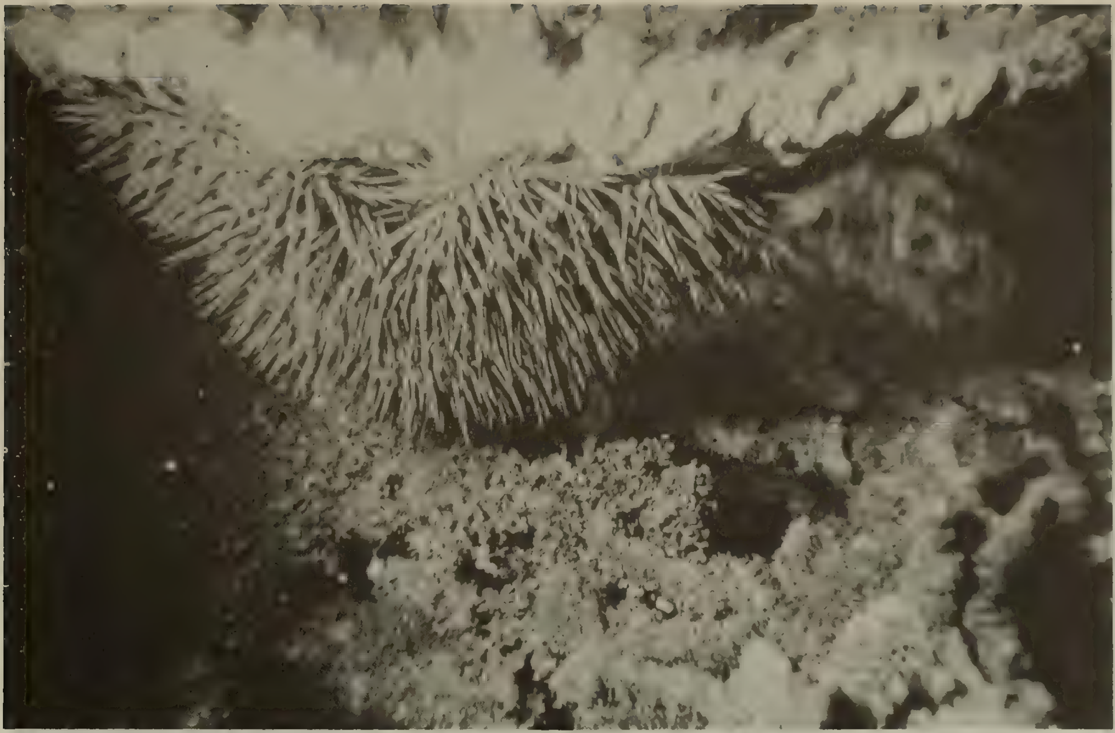
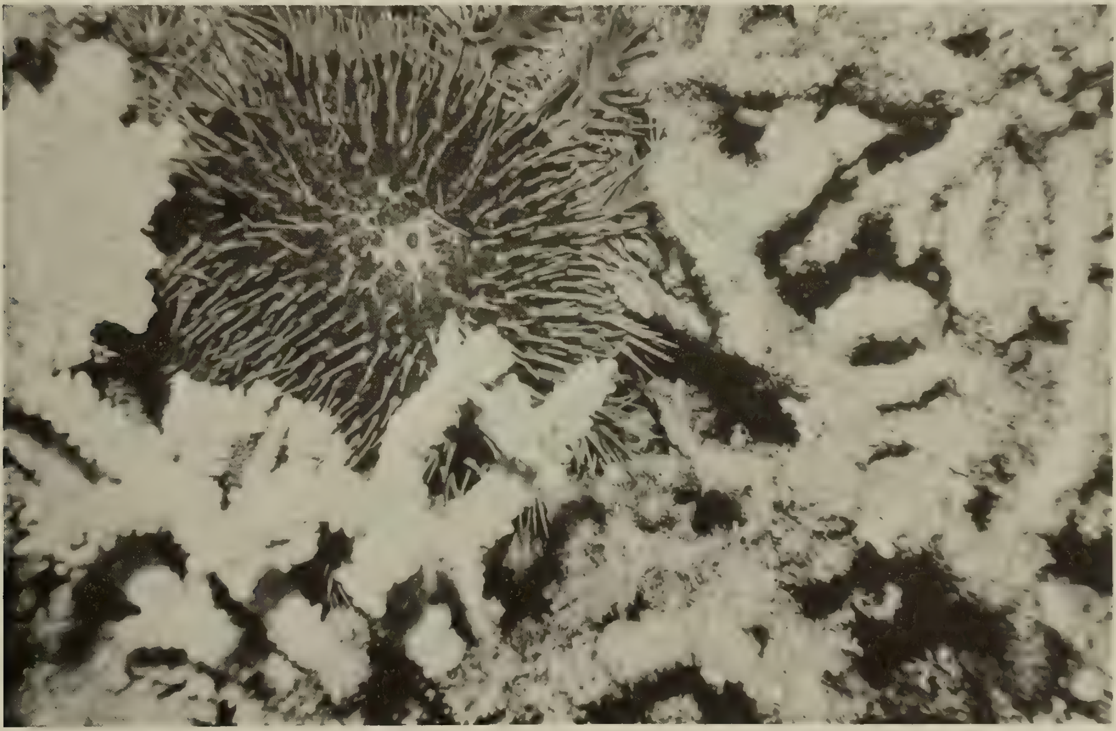


Plate II, figure A. Acanthaster planci on underside of recently eaten Acroporan coral. Mangareva Island, Station 3, depth 2 m, Dec. 12, 1970. Photo by D.M. Devaney.

Plate II, figure B. Acanthaster planci among branches of Acroporan coral. Older dead algal covered portions (right) and live coral (foreground, left). Mangareva Island, Station 3, depth 3 m, Dec. 12, 1970. Photo by D.M. Devaney.



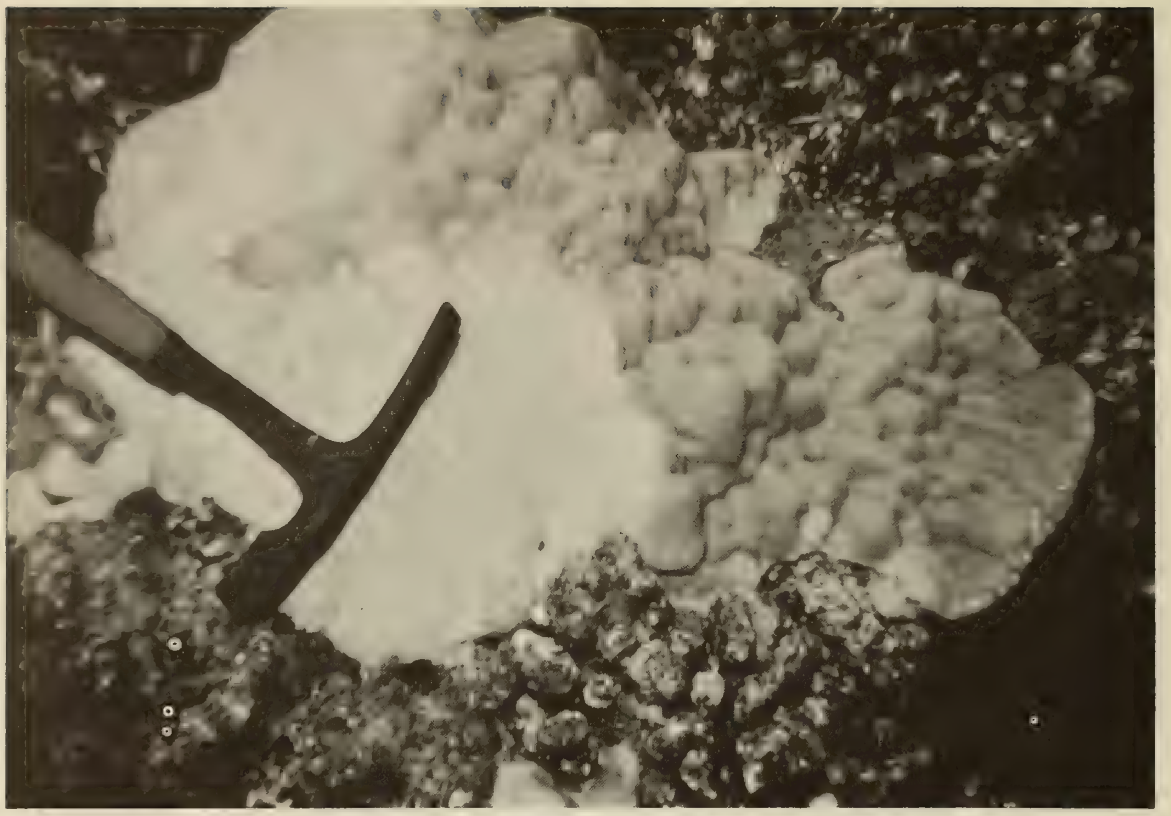
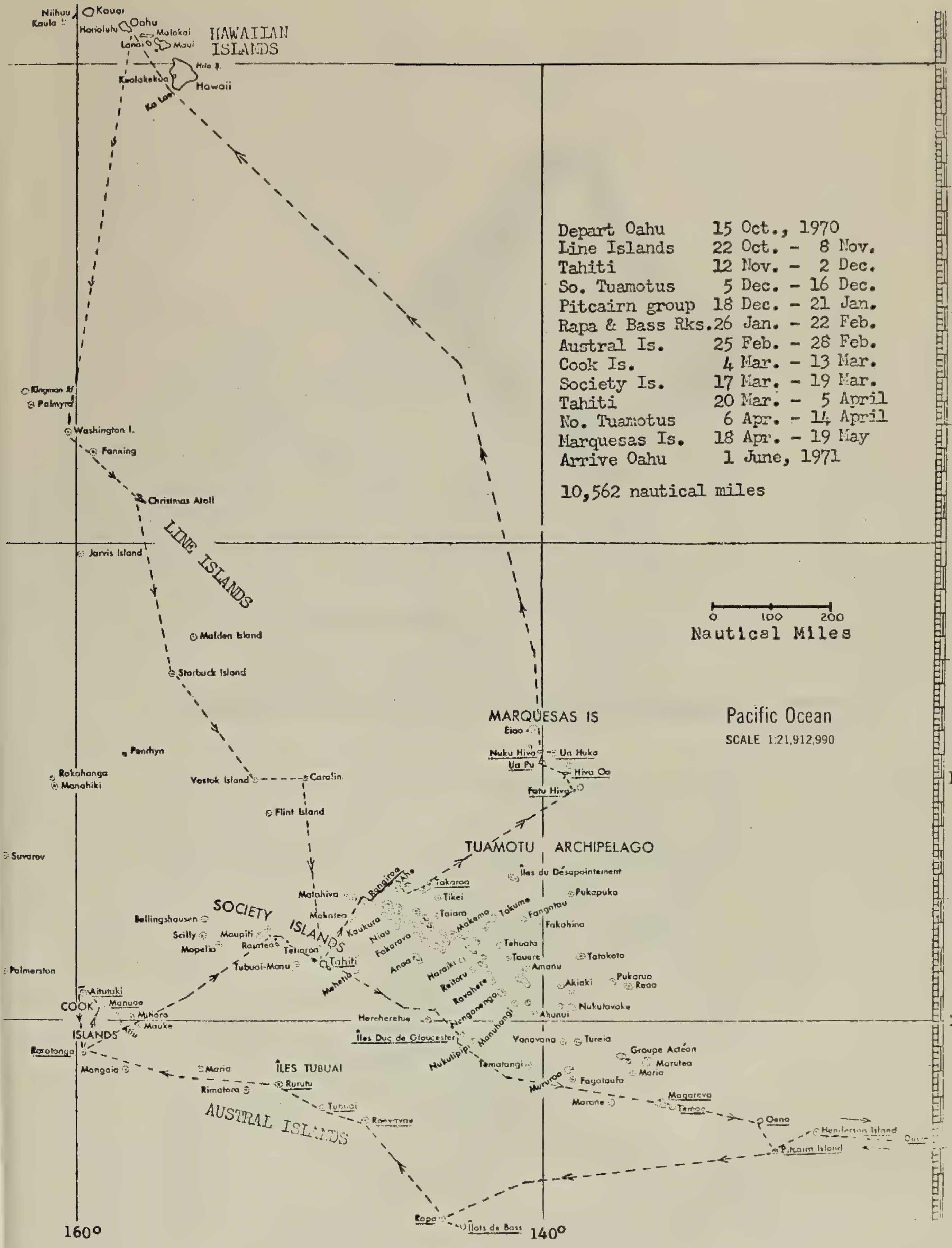


Plate III, figure A. Fresh feeding scar on Porites coral and surrounding dead branching corals. Rarotonga, Cook Islands, depth 30 m, Mar. 11, 1971. Photo by D.M. Devaney.



Depart Oahu	15 Oct., 1970
Line Islands	22 Oct. - 8 Nov.
Tahiti	12 Nov. - 2 Dec.
So. Tuamotus	5 Dec. - 16 Dec.
Pitcairn group	18 Dec. - 21 Jan.
Rapa & Bass Rks.	26 Jan. - 22 Feb.
Austral Is.	25 Feb. - 28 Feb.
Cook Is.	4 Mar. - 13 Mar.
Society Is.	17 Mar. - 19 Mar.
Tahiti	20 Mar. - 5 April
No. Tuamotus	6 Apr. - 14 April
Marquesas Is.	18 Apr. - 19 May
Arrive Oahu	1 June, 1971

10,562 nautical miles

Figure 1. Route of the "Westward" in Southeastern Oceania

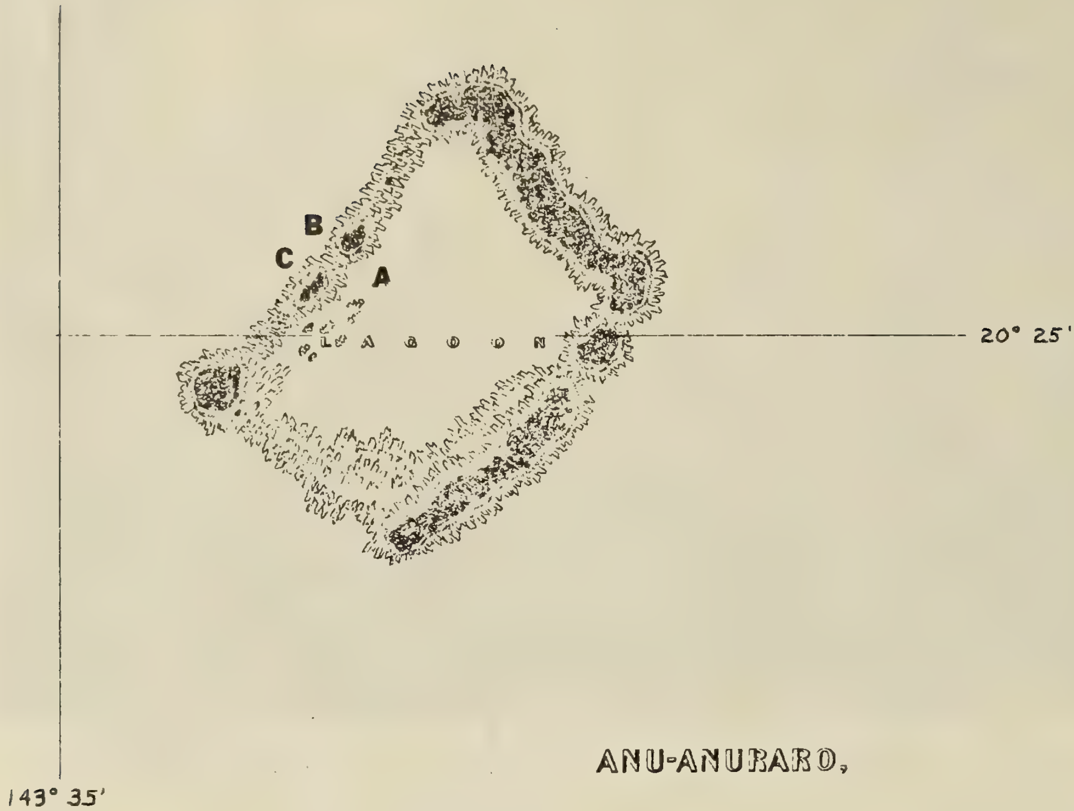


Figure 2. Anuanuraro Atoll, Tuamotu Archipelago

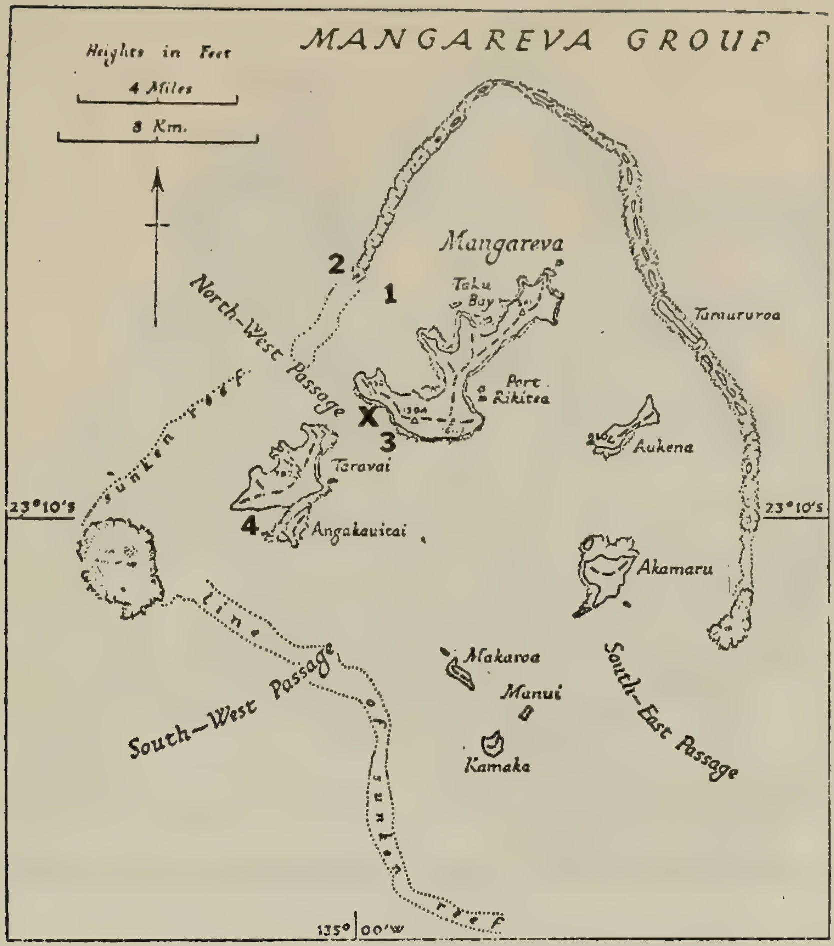


Figure 3. Gambier Islands, French Polynesia

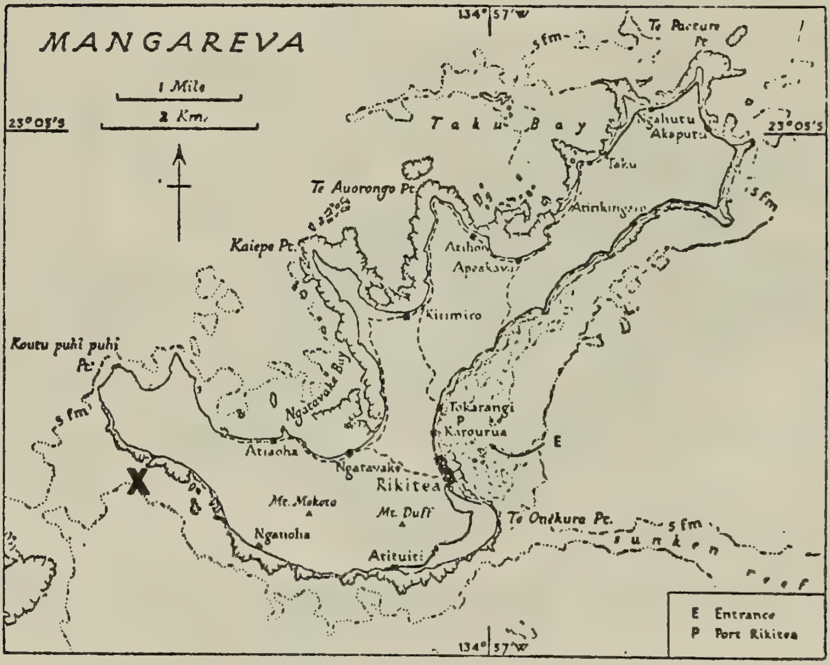


Figure 4. Mangareva Island

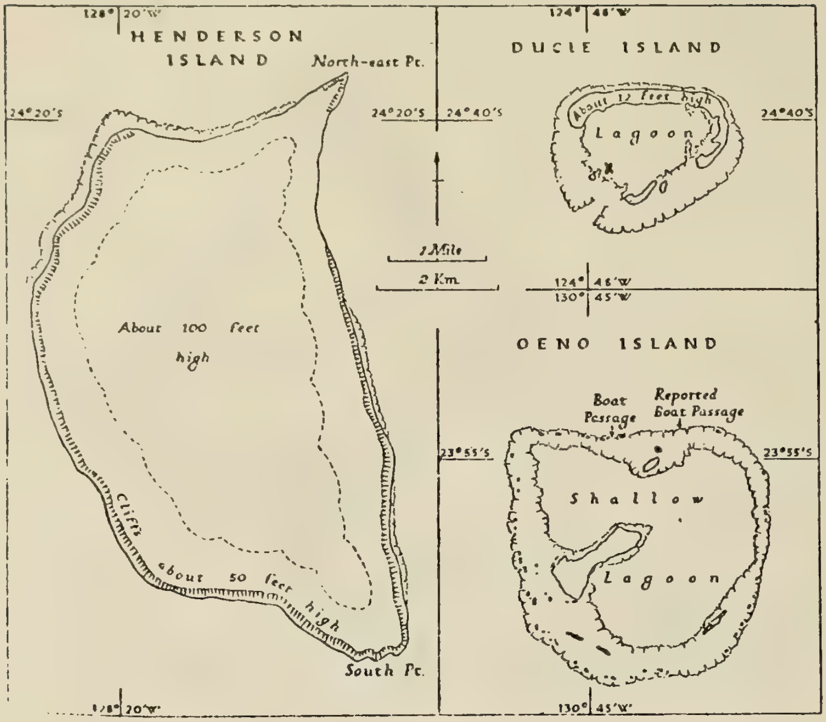


Figure 5. The islands of Oeno, Henderson, and Ducie

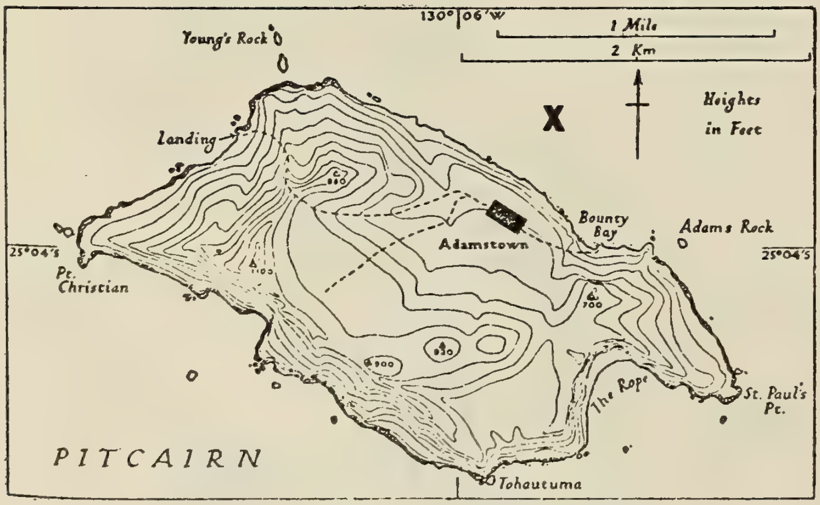


Figure 6. Pitcairn Island

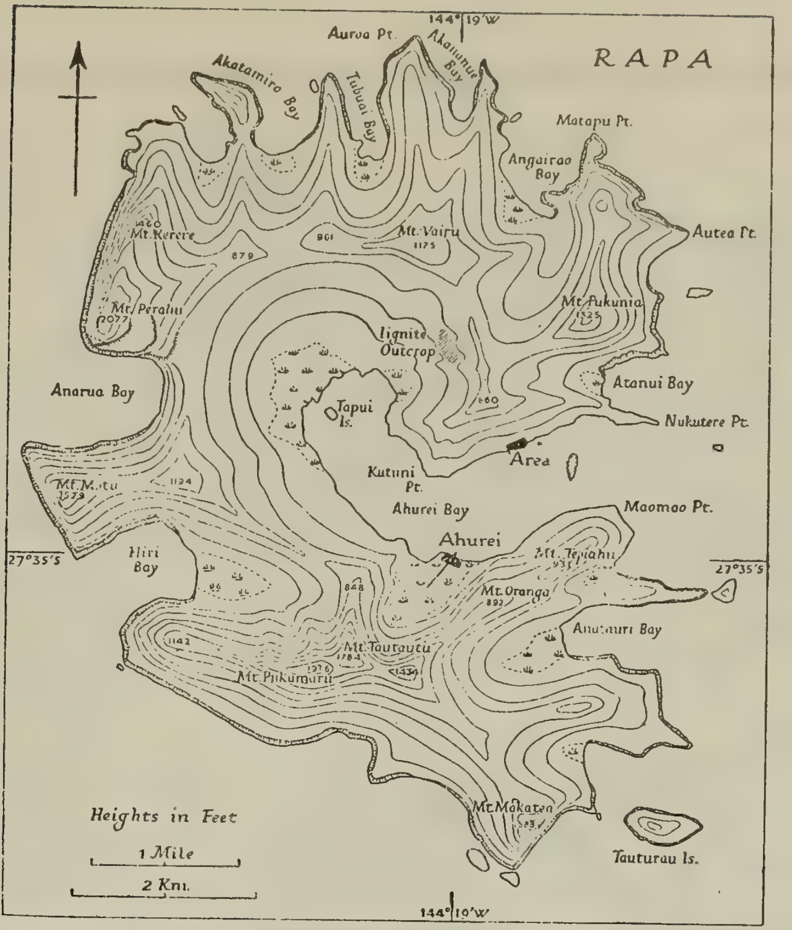


Figure 7. The island of Rapa

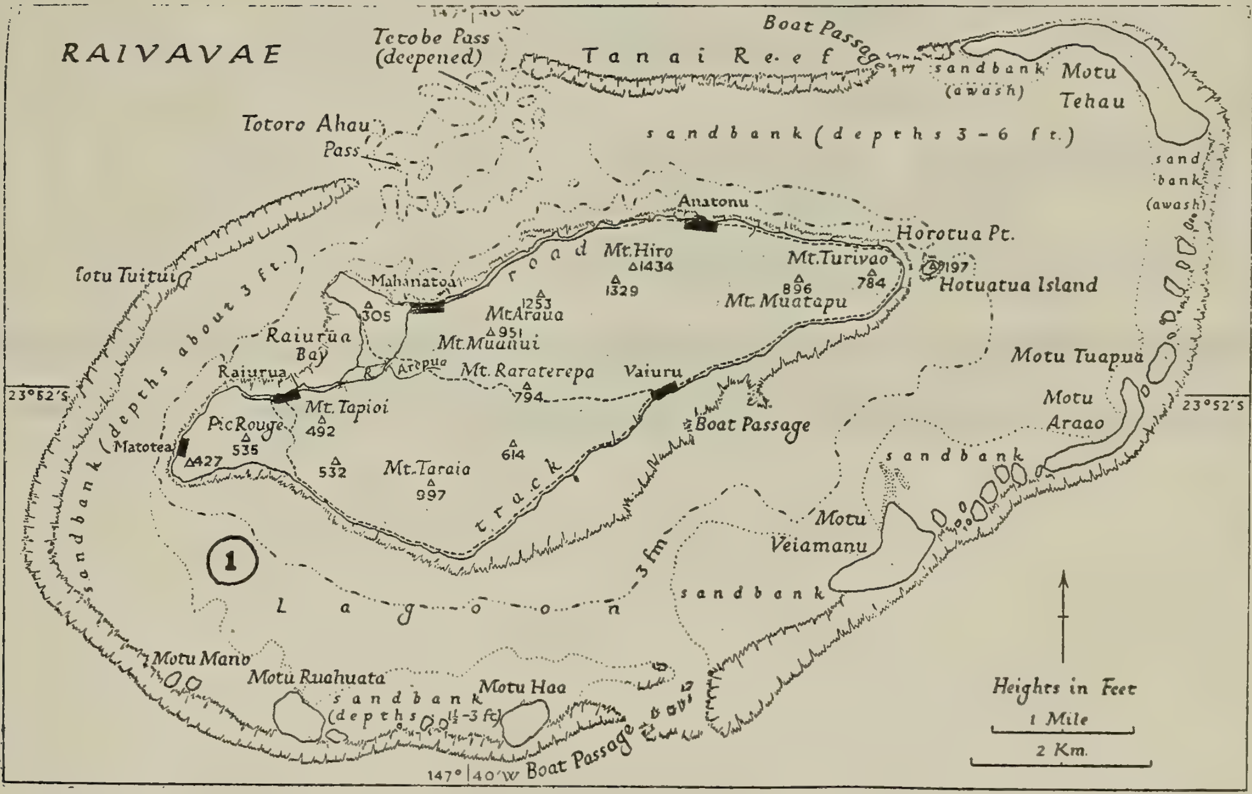


Figure 8. Raivavae, Austral Islands

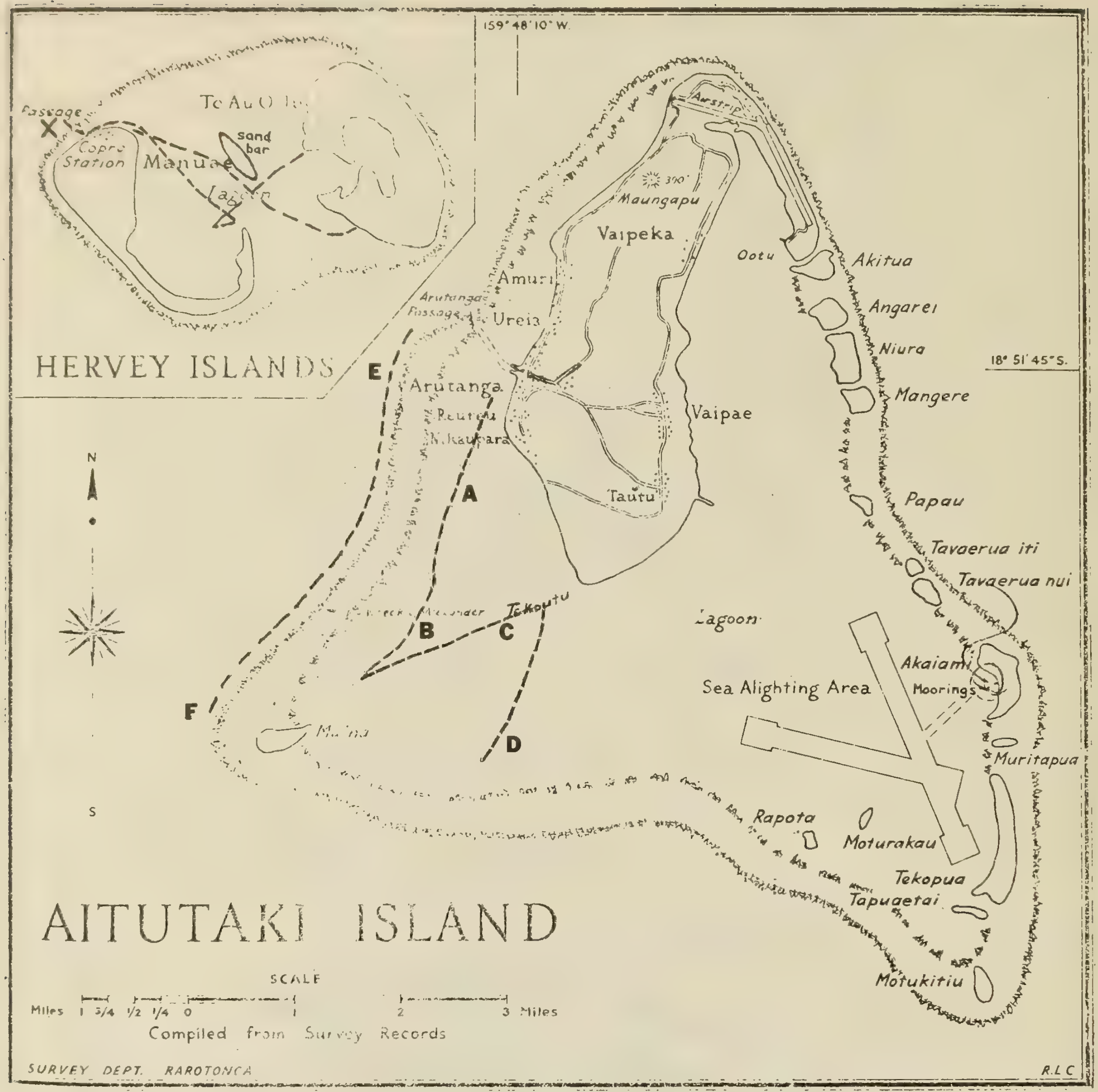


Figure 9. Aitutaki Island and Manuae (Hervey Islands), Cook Islands

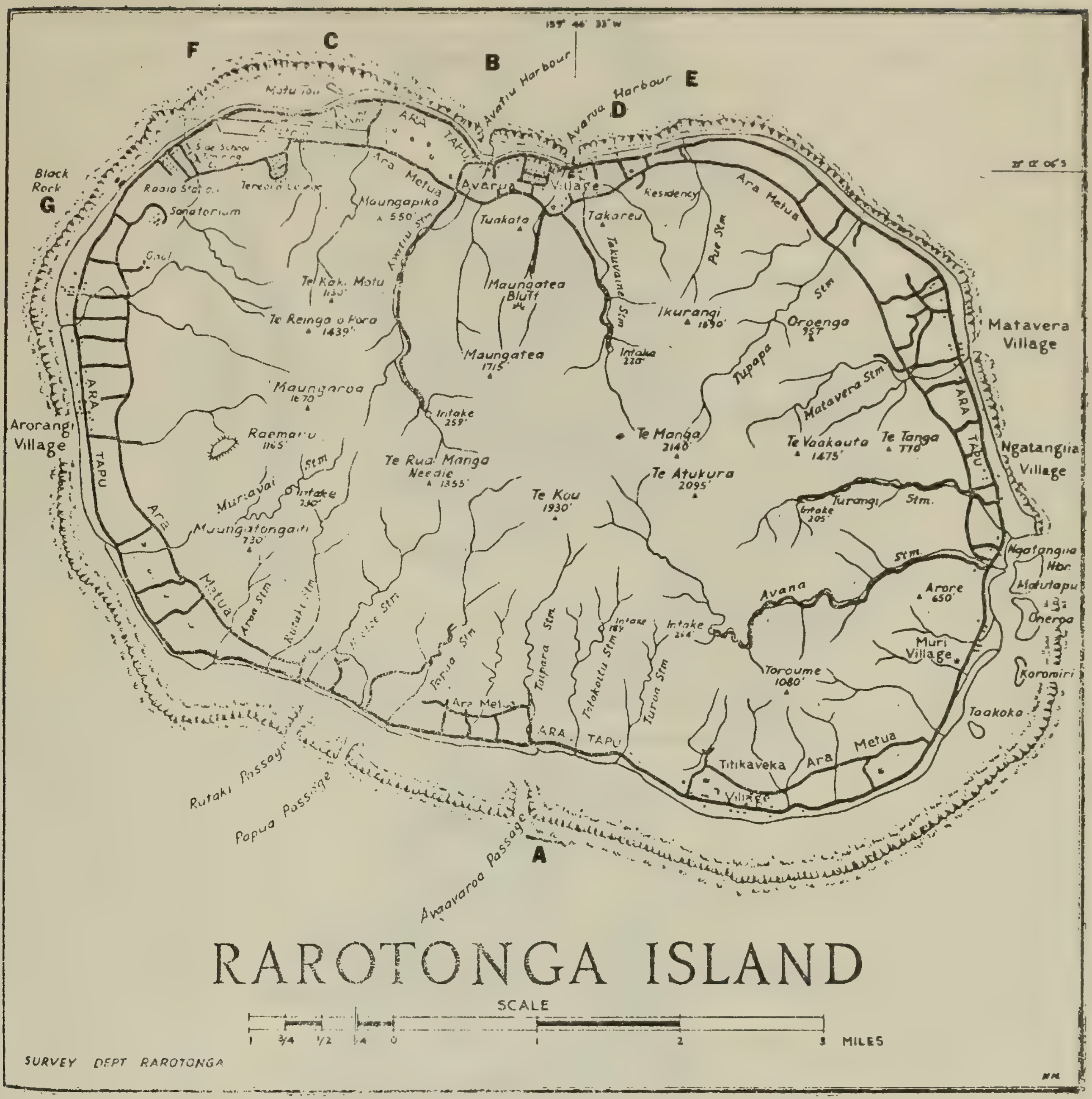


Figure 10. Rarotonga, Cook Islands

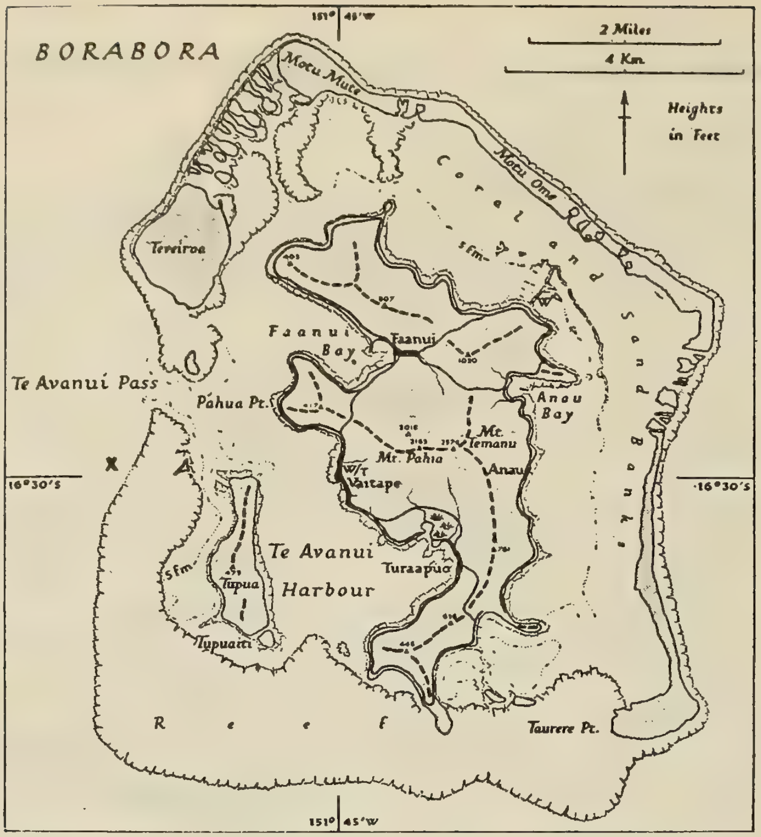


Figure 11. Bora Bora, Society Islands

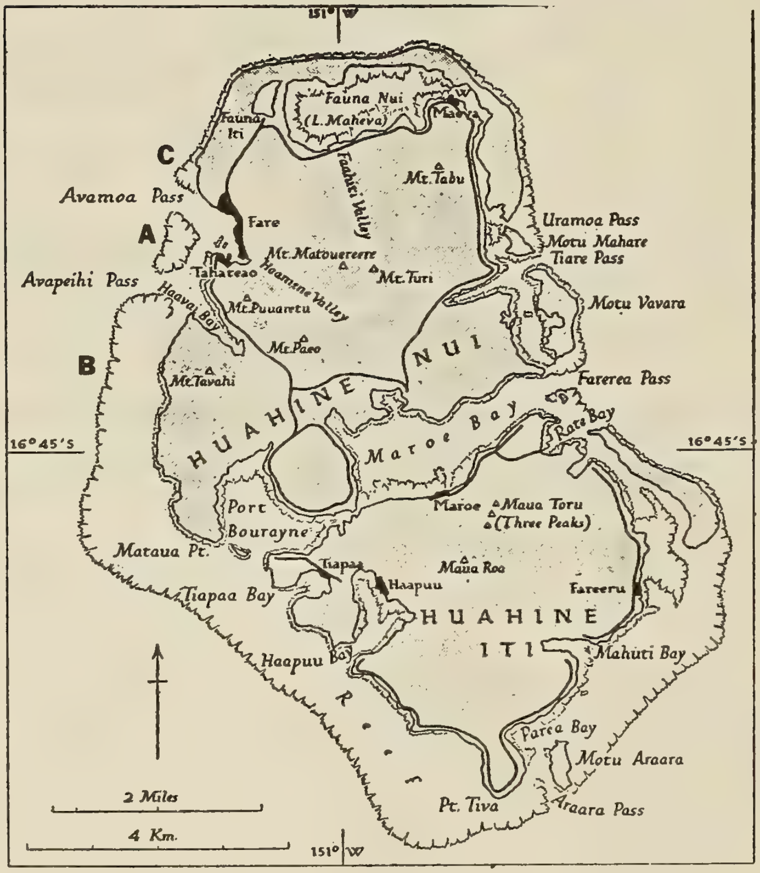


Figure 12. Huahine, Society Islands

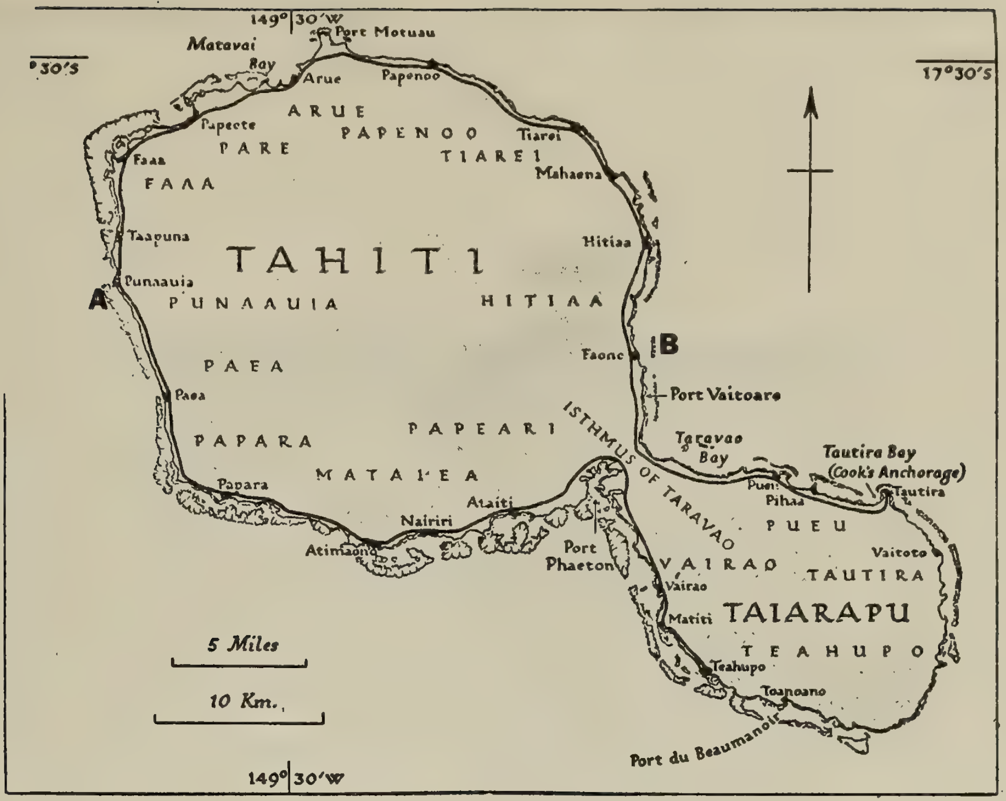


Figure 13. Tahiti, Society Islands

ATOLL RESEARCH BULLETIN

NO. 170

POPULATION LEVELS OF ACANTHASTER PLANCI IN THE MARIANA AND CAROLINE ISLANDS 1969-1972

by James A. Marsh, Jr. and Roy T. Tsuda

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Contents

Page

Introduction 1
Methods 2
Results 5
  Mariana Islands 5
  Western Caroline Islands 6
  Central Caroline Islands 7
  Eastern Caroline Islands 7
Discussion 8
Conclusion 9
References 9

POPULATION LEVELS OF ACANTHASTER PLANCI IN THE MARIANA AND CAROLINE ISLANDS 1969-1972[1]

by James A. Marsh, Jr.[2] and Roy T. Tsuda[2]

INTRODUCTION

The presence of large numbers of the crown-of-thorns starfish Acanthaster planci (Linnaeus) and its devastating effect on live coral reefs around certain Micronesian islands was first documented by a large-scale survey carried out by Westinghouse Electric Corporation in July and August, 1969 (Chesher 1969a). The survey indicated that there was, indeed, an abnormal population explosion of this animal on several islands, that the population explosion was of widespread occurrence, and that large areas of reef were being destroyed in certain islands beyond what could be considered a normal situation. There were, however, a number of islands which apparently had completely normal, healthy reefs.

Control efforts were subsequently organized in the Mariana, Palau, Truk, Ponape, and Marshall Island Districts of the Trust Territory of the Pacific Islands. The Yap District was not included at that time, because no abnormal Acanthaster populations were discovered in these islands by the Westinghouse survey. Control efforts consisted of divers injecting formalin into large numbers of individual starfish where the animals were found in aggregations.

Questions naturally arose as to whether or not there was a numerical increase or decrease in the starfish infestations after the original survey, and whether or not the reefs of new geographic areas were being invaded. There was also a desire to assess the effectiveness of the Trust Territory control program.

On May 3, 1970, a meeting of persons interested in the Acanthaster problem in Micronesia was held at the University of Guam. The primary objective of this meeting was to discuss a continuous starfish-monitoring program for Guam and the Trust Territory. A program was designed that would provide biologists from the University of Guam Marine Laboratory to resurvey certain islands for further information about the starfish.

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[1] Contribution No. 25 from the University of Guam Marine Laboratory.

[2] The Marine Laboratory, University of Guam, P. O. Box Ek, Agana, Guam 96910

(Manuscript received December 12, 1972--Ed.)

The monitoring program had a fourfold approach: 1) to assess population levels and general movement of starfish in newly infested areas, 2) to locate additional reef damage incurred since the 1969 survey, 3) to assess the control teams' efforts in each district, and 4) to observe any recolonization of corals in previously killed areas. A continued surveillance program was also expected to provide information on population dynamics and spawning cycles of starfish as well as other information of biological significance (e.g. potential fisheries, pollution, or such general abuse as overfishing, dynamiting, or poisoning fish). The Trust Territory Marine Resources Division provided travel, per-diem, and logistic support; the University of Guam Marine Laboratory provided expertise. Travel and logistic support was also kindly provided by the U. S. Coast Guard and the U. S. Navy.

During the period from June, 1970, to May, 1972, personnel from the University of Guam and the Trust Territory resurveyed the island of Guam (Tsuda, 1970) and 13 of the 16 Trust Territory islands previously visited by the ten Westinghouse teams. The islands included Rota (Tsude _et al_., 1970c), Saipan and Tinian (Tsuda _et al_., 1970b) in the Marianas; and Truk (Jones _et al_., 1970a), Nukuoro and Kapingamarangi (McDonald _et al_., 1970), Yap (Tsuda _et al_., 1970a), Palau (Tsuda _et al_., 1971a), Ponape and Ant (Tsuda _et al_., 1971b), and Lamotrek, Woleai and Ifalik (Bryan and Struck, 1971) in the Carolines. Also, Aguijan (Tsuda _et al_., 1970b), Kayangel (Tsuda _et al_., 1971a), and eight atolls in the Carolines (Bryan and Struck, 1971) were surveyed for the first time. In addition, a second resurvey was conducted a year later in Guam (Cheney, 1971), Saipan and Tinian (Marsh _et al_., 1972), Palau (Marsh and Bryan, 1972), Ponape (Wass, 1972a) and Truk (Wass, 1972b). During this latter period, Aguijan was resurveyed for the first time (Marsh _et al_., 1972).

The purpose of this paper is to summarize our findings on the population levels of _Acanthaster planci_ and their resultant damage to coral reefs on 27 islands and atolls in the Mariana and Caroline Islands between 1969 and 1972. The information is based on the surveys and resurveys conducted thus far in this area, as well as on information reported at an _Acanthaster_ workshop (Tsuda, 1972) held at the University of Guam in March, 1972.

METHODS

The basic field technique used in the original surveys and the resurveys was to tow two observers behind or alongside a boat at a speed of approximately two knots. The boat usually followed a zigzag pathway so as to provide a broader swath of coverage than would be the case if it travelled in a straight line. This allowed observations in both the shallower and deeper portions of an outer reef slope, and gave a more complete coverage within a given area. Thus, large areas of reef could be examined in a relatively short period of time.

Observers scanned the bottom on their side of the boat and counted the Acanthaster and fresh feeding sites seen. Fresh feeding sites were identifiable as distinct white spots standing out in marked contrast to the darker surrounding bottom. These white spots represented recent coral kills where the starfish had eaten away the soft tissues and exposed the skeletal remains of the coral. Early experience indicated that whenever white spots were seen from the surface, starfish could usually be found by divers in the immediate vicinity even if the animals were not obvious from the surface. They were often found in crevices or under tabulate growth forms of corals or in other shaded areas.

It was at times difficult to distinguish white spots left by Acanthaster from those left by other reef organisms (e.g. the pillow star Culcita novaeguineae). However, Culcita feeding sites usually have a more regular rounded appearance. Furthermore, Culcita are incapable of climbing onto the staghorn and tabulate Acropora which are the preferred food coral of Acanthaster.

The fresh surfaces are soon colonized by filamentous algae and other organisms, and take on a drab appearance which merges with the appearance of the surrounding substrate. According to Chesher (1969a), white spots indicate a coral kill within the past 48 hours.

An area was designated as "infested", or considered to have abnormal numbers of Acanthaster, when more than 20 animals and/or white spots were seen by two observers in 20 minutes (the usual duration of a towing period). Hence, counts of white spots and Acanthaster were lumped together in these considerations, and an average count of more than one per minute of towing was the threshold value. On some occasions, only one person was towed by the boat; thus, an average count of more than .5 starfish or white spots per minute would then be the threshold value. This also allowed standardization of tow periods of shorter or longer duration, as well as the swims made in areas of extremely rugged terrain or shallow water. Spot checks, usually lasting a minute, were made in "sharky" areas. The techniques did, however, lead to difficulties in converting counts into numbers per unit of reef surface or numbers per linear unit of reef face. Hence, data were usually recorded as counts per minute of towing or swimming time.

Reef conditions reported in Table 1 were assigned according to the classification of Chesher (1969a). This provided a more extensive evaluation than simply designating an area "infested" or "not infested". A brief description of Chesher's classification scheme follows.

Condition 1 is considered a normal situation, with few A. planci and the reefs healthy and undamaged. This condition was assigned when fewer than one starfish per minute of towing (two observers) was found.

Condition 2 exists when concentrations of starfish and feeding sites are found in localized areas, with only slight damage to surrounding reef areas; there are no extensive dead reef areas. Chesher (1969a) considered this a "seed" population preliminary to a more extensive infestation. However, here we designate some reefs as Condition 2 without implying that we expect this to necessarily lead to larger aggregations of starfish or widespread reef damage.

Condition 3 denotes large populations of A. planci found with an extensive depth distribution; many of these are aggregated into herds. Damage to the reef is fresh and extensive, and patches of completely dead reef are interspersed with live reefs. Chesher considered this to be an intermediate stage of short duration.

Condition 4 represents a situation where large populations of starfish are aggregated into one or more fronts, leaving behind almost completely dead reefs. There may be thousands of individuals in these fronts.

Condition 5 describes extensive reef areas of all or part of an island composed primarily of dead coral, with the damage attributable to A. planci. According to Chesher, there may still be large numbers of starfish present, or most of these may have dispersed. In this paper we have been extremely careful in attributing dead reefs to A. planci unless we have evidence from at least one resurvey that damage can be definitely attributed to starfish infestations previously observed. We believe that it is assuming too much to attribute dead reef areas to starfish activity unless there is some documentation of such activity.

Condition 6 is Chesher's designation for a postulated condition in which there was a minor population explosion, apparently to the level of Condition 2, followed by dispersal. Chesher considered this condition as a hypothetical case which required further documentation.

Like Chesher (1969a) and Goreau et al., (1969), we believe that the towing technique is effective for locating and defining the limits of major infestations of A. planci, for gaining an overview of general reef conditions, and for making a reasonable qualitative judgement of the effects of the predator on the reef. Large areas of reef can be covered. However, the technique is not effective for a precise population census; and our numbers of starfish and white spots recorded are approximate indicators of the total population.

RESULTS

Results of all surveys and resurveys conducted in the Mariana and Caroline Islands are elaborated below and also summarized in Table 1.

MARIANA ISLANDS

Guam: Information on the distribution of populations and migrations of *A. planci* on Guam from early 1967 to May, 1969, was presented by Chesher (1969b). The infestation began in 1967 on the leeward (western) side and spread over most of the leeward coast. One population rounded the northernmost point and continued down the windward coast. Much of this population has now been killed, but remnants of it still remain near Catalina Point. Scattered individuals have appeared further south on the windward coast. Some remnants of a second population are still found along the southern part of the leeward coast. Starfish and feeding sites can also be found commonly in the southern lagoon. There appears to have been a stabilizing trend in the last 18 months or so.

Saipan: Goreau *et al.* (1969) reported large numbers of starfish in the summer of 1969, concentrated primarily on the leeward (western) coast inside and outside the barrier reef. By August, 1970, almost all these starfish had disappeared, but the numbers reported in 1969 could not be accounted for in the records of the control team. In 1970 there was a small remnant population left on the western barrier. By October, 1971, the numbers of starfish and feeding sites were completely within normal limits, although there were extensive areas of mostly dead reef attributable to *A. planci*. Most coral areas on the windward side remain live and luxuriant.

Tinian: This island was reported as primarily dead in 1969, with above-normal populations of *A. planci* in several areas. Most dead areas were attributed to past starfish activities. Starfish worked both sides of the island, mostly on the outer reef slopes but with some coral kill on the reef flat areas. In 1970 expanded dead coral areas were noted in the localities of the 1969 infestations. There was a further decline in starfish numbers between August, 1970, and October, 1971, with only one small population found on a reef top inside the western fringing reef in 1971.

Rota: This island was reported as infested in 1969, with large numbers of *A. planci* and extensive reef damage. Further reef damage was found in 1970, but the starfish were declining in numbers. Apparently the situation was near stabilization in 1970.

Aguijan: This small island (less than 5 km long) was surveyed for the first time in 1970 and found to have a major infestation in progress. The number of starfish was conservatively estimated at 4,000-5,000, and there was extensive coral damage. By 1971 all A. planci had disappeared, and almost all coral was dead. This island originally had only scattered corals colonizing a rock platform; there was never a true infrastructure formed by reef-building organisms.

WESTERN CAROLINE ISLANDS

Palau: Four localized areas with infestations were pinpointed in 1969; all of these had extensive dead coral when surveyed in 1970. There was a marked decline in A. planci numbers between 1969 and 1971, and the situation in 1972 was similar to that seen a year previous. Starfish and white spots can still be found commonly in the Seventy Islands, although this area is mostly dead now. No starfish have ever been seen outside the barrier reef, despite extensive surveys in 1971 and 1972.

Kayangel: Only nine fresh feeding sites and no Acanthaster were observed on this atoll near Palau. The reefs appeared normal and healthy.

Yap: Only a few starfish and feeding sites were seen in 1969 and 1970. Reports by local residents of increasing numbers of A. planci led to the establishment of a control team in 1971. This team reportedly killed over 5,000 starfish, apparently from widely scattered areas. There is no evidence of any major concentrations.

Woleai: A small population of A. planci and scattered coral damage was reported on the inner side of the barrier in both 1969 and 1971, but the animals were apparently well dispersed. The 1969 survey team felt that this was a situation which would bear watching, but there was essentially no change in the next 22 months after their survey.

Ifalik: Only three starfish were found in 1969. No starfish, but 41 feeding sites, were found in 1971. The reefs were healthy, and the status did not change in 22 months.

Lamotrek: Only one starfish was reported in 1969. A minor infestation appeared to be in progress in 1971, with four Acanthaster and 96 feeding sites reported. The reefs generally were reported as "lush, normal, and healthy" both times.

Eauripik, Elato, Faraulep, Olimarao and Satawal: These islands were surveyed for the first time in 1971. There were signs of minor infestation at Faraulep; but, in general, all reefs appeared normal and healthy.

CENTRAL CAROLINE ISLANDS

Truk: Areas of major infestation were found in 1969. In 1970 these areas had more extensive dead reef. Apparently a major infestation continues to this day, even though large numbers of Acanthaster have been killed. Starfish have been found outside the barrier reef and on numerous patch reefs inside the lagoon. They have been more common on lagoon patch reefs than outside the barrier in recent months. Truk has the largest lagoon in Micronesia, and its barrier and patch reefs have not been thoroughly surveyed since 1969.

Kuop: This small atoll near Truk had only one specimen of A. planci in 1969, but all its reefs appeared to have been substantially killed off at some time in the past. There is no convincing evidence that the kill was due to Acanthaster.

Puluwat, Pulap, and Pulusuk: These islands were also surveyed for the first time in 1971. Only 25 starfish were seen on these three islands. A minor infestation was observed on the outer western reef of Pulusuk, but all reefs examined appeared normal and healthy.

EASTERN CAROLINE ISLANDS

Ponape: This island was rated Condition 4 by Chesher, who believed that it had recently passed from Condition 3. We rate it Condition 3 for 1971 and 1972 and believe that Condition 3 may have been a better assessment of the 1969 situation. Large numbers of starfish have been reported killed by the control team. There has been significant Acanthaster activity both inside and outside the barrier reef.

Ant: This small atoll near Ponape was reported as essentially dead by the 1969 survey team. However, the 1971 team found large areas of exceedingly luxuriant reef in localities where the 1969 team had not surveyed. The 1971 team also corroborated the 1969 team's findings of large areas of dead coral but did not feel that these could necessarily be attributed to Acanthaster. Both teams saw small numbers of starfish.

Mokil: This island was surveyed briefly in 1969. There were scattered A. planci along the entire western coast but not enough to prevent the reefs being classified as normal.

Pingelap: The entire barrier reef and lagoon were surveyed in 1969. There was some question as to whether this should be classified as Condition 2 or Condition 6. Along the southern and western coasts there were relatively large numbers of A. planci and numerous freshly killed corals, as well as much algae-covered coral. Elsewhere the reefs appeared normal.

Chesher believed that Pingelap had a seed population that had not had enough recruitment to continue rapid expansion. Pingelap has not been resurveyed.

Nukuoro: There was a fairly large *A. planci* population in 1969 and some dead coral areas. The atoll was resurveyed in 1970, and a team member who went on both surveys estimated that there had been a population increase of 30-40% over the 1969 condition. He still considered the starfish population to be within normal limits, however.

Kapingamarangi: Small numbers of *A. planci* were seen in 1969 and 1970, but the reefs were considered normal and healthy both times.

DISCUSSION

The resurveys show that there has been a definite overall decrease in *Acanthaster planci* populations since the original survey in the summer of 1969. In no case has there been a major new starfish outbreak since that time, with the probable exception of Aguijan. There has not been a major advance of an outbreak from Condition 2 to Condition 3 or from Condition 3 to Condition 4.

Of the islands reported as Condition 4 in 1969 (Guam, Saipan, Rota, Truk, and Ponape), there has been a marked decrease in starfish numbers on three islands (Guam, Saipan, and Rota) and a slight decrease on two islands (Truk and Ponape). Hence, Guam, Saipan, and Rota are now listed in Condition 5 because they have passed beyond Condition 4, even though these islands still have extensive areas of healthy reef. Truk and Ponape apparently still have large numbers of *A. planci* but have much live reef remaining as well; hence, they are downgraded to Condition 3.

Of the other islands surveyed and resurveyed from 1969 to 1972, two larger islands (Yap and Palau) and a number of smaller islands have not experienced a major *Acanthaster* infestation. Palau apparently passed from Condition 2 to Condition 6 without having a large-scale outbreak, and there is no evidence that Yap ever had higher than normal starfish counts.

We attribute the marked overall decline in *A. planci* infestation on these islands at least in part to control efforts, which have resulted in the killing of approximately 280,000 starfish (as of February, 1972)--63,000 in Guam, 14,000 in the Mariana District, 16,000 in the Palau District, 5,000 in the Yap District, 113,000 in the Truk District, and 69,000 in the Ponape District. The case is most clearly documented for Guam, where control efforts obviously broke up the large migrating herds reported by Chesher (1969b). This situation probably applies to Saipan as well. We also suspect that control efforts in Palau prevented the infestation there from advancing beyond the level of Condition 2.

An exception to the suggestion of control activities as the cause of population decline is the situation that occurred on Aguijan, a small uninhabited high island in the Marianas. Personnel on the August, 1970, survey counted 3753 Acanthaster on the upper terrace and seaward slope around this island. In contrast to our original observations, only a single starfish and three feeding sites were seen during the resurvey in October, 1971. No control efforts were ever carried out on Aguijan. This is also the only case where the starfish simply migrated elsewhere on their own after killing almost all of the corals around the island.

CONCLUSION

Based on our three-year surveillance of the population levels of Acanthaster planci in the Mariana and Caroline Islands, we conclude that this organism is definitely on the decline and currently poses no widespread threat to the remaining reefs of Micronesia. This conclusion is based on repetitive field observations of the same areas, in contrast to the speculation which has characterized much of the discussion of the Acanthaster problem.

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Table 1. Summary of results of surveys and resurveys, 1969-1972.

ISLAND	DATES SURVEYED	CONDITION	TOTAL MAN-HOURS	TOTAL A. PLANCI	TOTAL FEEDING SITES	LOCATION OF POPULATIONS
MARIANA ISLANDS						
Guam (High island)	Nov. 68- Aug. 69	4	-	-	-	Outside W & N fringing reef
	Sept. 70	5	46	418	956	Outside NE & W fringing reef; southern lagoon
	April 71	5	-	-	-	Same as Sept. 70
Saipan (High island)	July 69	4	ca 25	1880	-	Outside & inside western barrier; NE tip
	Aug. 70	5	16.9	53	355	Western barrier
	Oct. 71	5	13.6	2	20	None
Tinian (High island)	July 69	5	29.7	324	-	Outside eastern fringing reef; outside western fringing reef; northern tip
	Aug. 70	5	13.5	189	258	Same as July 69
	Oct. 71	5	5.3	34	37	Inside western fringing reef

ISLAND	DATES SURVEYED	CONDITION	TOTAL MAN-HOURS	TOTAL A. PLANCI	TOTAL FEEDING SITES	LOCATION OF POPULATIONS
Rota (High island)	July 69	4	13.0	2926	-	Outside southern fringing reef; outside N fringing reef
	Oct. 70	5	16.0	369	392	Outside SE fringing reef; outside N fringing reef
Aguijan (High island)	Aug. 70	4	4.3	3753	ca 5000	Continuous around island
	Oct. 71	5	4.0	1	3	None
WESTERN CAROLINE ISLANDS						
Palau (Group of high islands surrounded by barrier)	April 69	2	-	-	-	N fringing reef inside barrier; patch reefs inside lagoon; reef tops near harbor entrance
	Jan. 71	6	63.0	179	1079	Patch reefs inside lagoon
	Jan. 72	6	69.8	201	889	Patch reefs inside lagoon; inside W barrier
Kayangel (Atoll)	Jan. 71	1	3.3	0	9	None

ISLAND	DATES SURVEYED	CONDITION	TOTAL MAN-HOURS	TOTAL A. PLANCI	TOTAL FEEDING SITES	LOCATION OF POPULATIONS
Yap (High islands surrounded by barrier)	July 69	1	-	20	-	None
	Nov. 70	1	36.4	11	173	Outside W barrier
	May 71-Feb. 72	1	-	5270	-	Scattered individuals inside & outside barrier
Woleai (Atoll)	July 69	1	17.0	ca 20	-	Inside W barrier
	May 71	1	2.7	1	76	Same as July 69
Ifalik (Atoll)	July 69	1	ca 17.5	3	-	None
	May 71	1	3.7	0	41	None
Lamotrek (Atoll)	Aug. 69	1	31.5	1	-	None
	May 71	1	10.0	4	161	Outside SW & N reefs
Eauripik (Atoll)	May 71	1	2.7	2	27	Outside S reef
Elato (Atoll)	May 71	1	.3	0	7	None
Faraulep (Atoll)	May 71	1	2.0	1	82	Scattered outside reef
Olimarao (Atoll)	May 71	1	4.0	0	30	Scattered outside reef

ISLAND	DATES SURVEYED	CONDITION	TOTAL MAN-HOURS	TOTAL A. PLANCI	TOTAL FEEDING SITES	LOCATION OF POPULATIONS
Satawal (Island with fringing reef)	May 71	1	1.7	0	24	None
CENTRAL CAROLINE ISLANDS						
Kuop (Atoll)	July 69	5	-	1	-	None
Truk (Group of high islands surrounded by large lagoon and barrier reef)	July-Aug. 69	4	125.5	463+	-	N outer edge of barrier; outside barrier near NE pass; patch reefs inside lagoon
	June 70	3-4	-	-	-	Same as July 69
	July 72	3	11.7	35	321	Patch & fringing reefs inside lagoon
Puluwat (Atoll)	May 71	1	2.7	1	12	None
Pulap (Atoll)	May 71	1	5.3	6	83	Outside NW reef
Pulusuk (Island with fringing reef)	May 71	1	1.7	18	36+	Outside W & SW reef
EASTERN CAROLINE ISLANDS						
Ponape (High island with barrier reef)	July-Aug. 69	4(3)	28.0	477+	-	Inner portion of S barrier reef; inner portion of NE barrier; inner & outer portions of N barrier

ISLAND	DATES SURVEYED	CONDITION	TOTAL MAN-HOURS	TOTAL A. PLANCI	TOTAL FEEDING SITES	LOCATION OF POPULATIONS
	April 71	3	30.4	298	ca 2400	Outside entire W, N, & NE barrier; scattered localities on inner portion of barrier
	Feb-Mar. 72	3	39.0	353	1792	Inside & outside SW barrier & patch reefs inside SW lagoon; outside NE barrier; inside & outside reef near E pass
Ant (Atoll)	July 69	5	11.2	54	-	Inner portion of reef; lagoon side of SE pass
	April 71	2	2.0	1	133	Outside NE tip of reef; outside NW tip of reef
Mokil (Atoll)	July 69	1	-	-	-	None
Pingelap (Atoll)	July 69	2	29.0	38	-	Outside S & W reef
Nukuoro (Atoll)	July-Aug. 69	6	-	-	-	Outside S reef
	July 70	6	-	-	-	None
Kapingamarangi (Atoll)	July 69	2	-	-	-	Inside SW reef; outside SW reef
	July 70	1	-	-	-	None

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